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Modern Isolated Plant of the B. & O. Railroad

RECENTLY-ERECTED CHICAGO TERMINAL CONTAINS NOVEL COAL AND ASH HANDLING ARRANGEMENT, WATER TUBE BOILERS, HIGH-SPEED ENGINE-DRIVEN ELECTRIC GENERATING UNITS AND AIR COMPRESSORS; NEW METHOD OF HANDLING LOCOMOTIVE SMOKE IN ROUND HOUSES EMPLOYED

AFTER ANY EXTENDED financial depression such as this country experienced within the past 2 or 3 yr., the return of improved business conditions is generally heralded by renewed activity on the part of the most important industries, such as the steel mills and the railroads. As these industrial organizations are the first to feel the effects of approaching hard times and make curtailments on all but absolutely necessary expenditures they are likewise, as a rule, the first to realize and take advantage of the return of prosperity. A single proof of this is exemplified by the large car-storage yards, road-and-rolling-stock-equipment storage, repair shops and round house recently constructed by the Baltimore and Ohio Railroad Co. on West 14th St., between Wood and Robey Sts., Chicago. In addition to caring for the rolling stock of the above-mentioned company, these shops and round houses also afford terminal facilities for a number of other lines entering Chicago, such as the

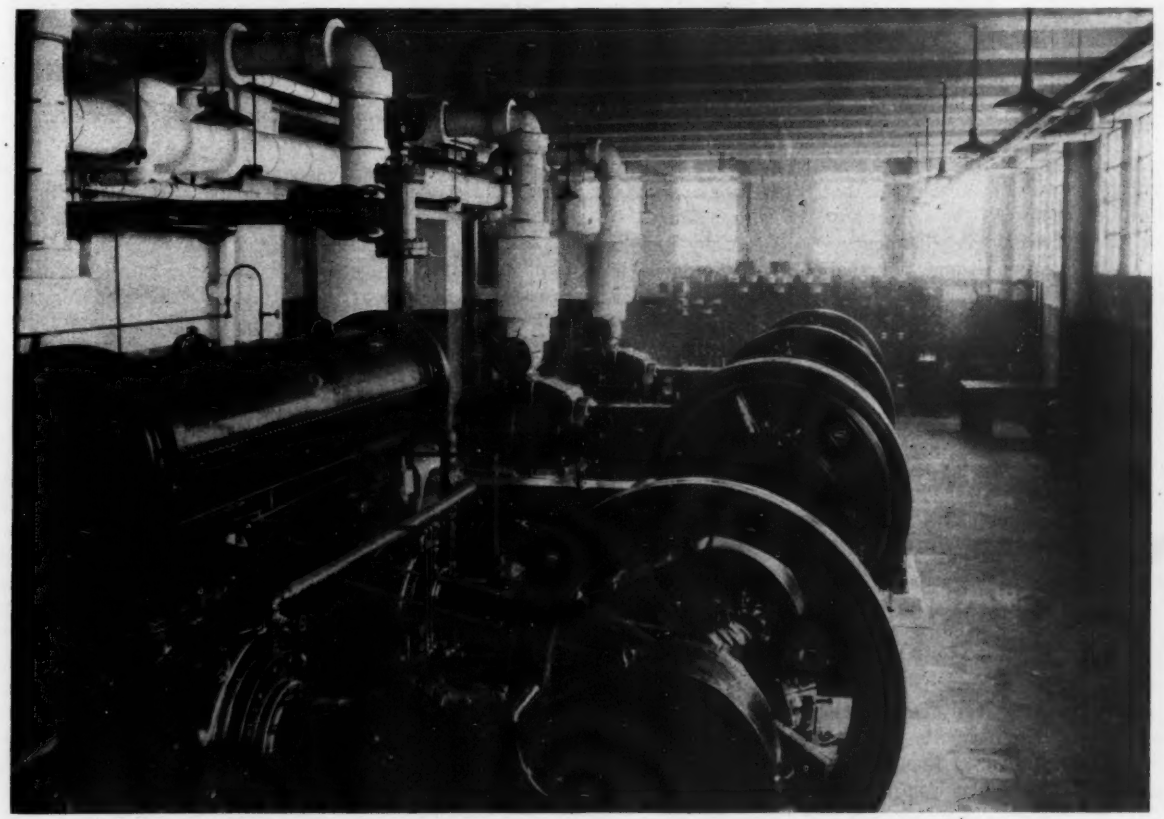


FIG. 1. THE ORDERLY ARRANGEMENT OF THE ENGINE ROOM IS TYPICAL OF THAT EMPLOYED THROUGHOUT THE PLANT

Great Western, Soo, Pere Marquette and the Baltimore and Ohio Chicago Terminal. All Pullman cars handled by these lines are also brought here for storage, cleaning and minor repairs.

Completely equipped carpenter, woodworking, forge and machine shops, storage and supply rooms, local administration offices and a modern isolated power plant furnishing electric light and power, heat, hot water and air, are housed in a 2-story-and-basement steel and concrete structure between Wood and Lincoln Sts. The round house, a single-story steel and brick structure located in the adjacent block between Lincoln and Robey Sts., can accommodate 32 large standard-type locomotives. It is equipped with machine and forge shops and a modern locomotive-boiler wash-and-fill system.

An interesting feature found here is the method employed to dispose of the smoke from the locomotive stacks. In the old type of building, the engine is so placed that its stack is directly under a hood extending through the roof of the building and opening to the

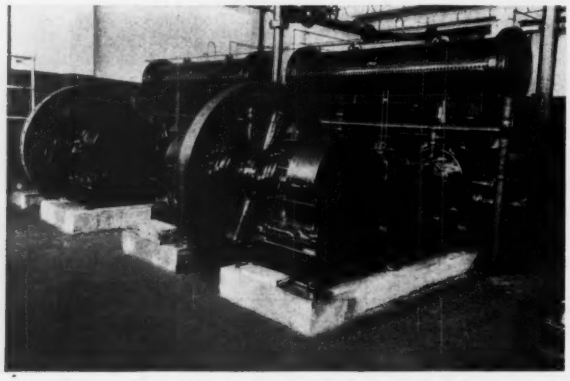


FIG. 2. ENGINE-DRIVEN AIR COMPRESSORS SUPPLY THE PNEUMATIC TOOLS WITH AIR

atmosphere which under the best conditions of draft allows more or less smoke to enter the round house. To eliminate this disagreeable feature and thereby improve the working conditions for those here employed, the hoods, instead of opening directly to the atmosphere, connect to a tapering metal duct having a maximum cross section of 62 by 132 in., and leading to the suction of a 108-in. motor-driven fan exhausting into a 180-ft. brick stack, the internal diameter of which at the base is approximately 12 ft.; the motor driving this fan is rated at 100 hp. As a result, the atmosphere in the round house is as clear as that outside.

The Power Plant

Electric energy is required throughout the buildings and about the yards for various purposes, such as the operation of the shop machines and tools, freight elevators of which there are 2, each having a capacity of 10,000 lb., and operated by a 20-hp. motor, coal- and water-handling equipments, charging of storage batteries and all indoor and outdoor lighting. Steam is employed for the operation of the air compressors and electric generating units and the heating of the buildings and coaches in storage or undergoing repairs or cleaning, while hot water is used for locomotive-boiler wash and fill purposes. The many pneumatic tools, such as riveters, calkers, jacks, sand conveyors, etc., call for a large supply of compressed air.

To meet these diversified requirements, a power plant, typical of present-day mechanical and electrical engineering practice, was installed and placed in operation on Dec. 15, 1915.

Access may be had to the engine room, which occupies the northwest corner of the basement of the main building, through the entrance on 14th St., a few steps east of Lincoln St. Entering here, the visitor is confronted with the view shown in Fig. 1. The equipment here installed, and in the order illustrated, consists of 2, 14 and 22 in. by 19 in. and 12 by 14 in. by 19 in., 2-stage, cross-compound air compressors manufactured by the Chicago Pneumatic Tool Co. and having a capacity of 963 cu. ft. of air per minute each at a pressure of 100 lb. gage, and 3 steam-driven electric-generating units each consisting

FIG. 3. SWITCHBOARD USED FOR EXCITER, GENERATOR AND FEEDER CONTROL

of a 150-kw., 440-v., 3-phase, 60-cycle Western Electric alternating-current generator direct connected to a 16 by 20 in. Ridgway automatic engine rated at 225 hp. and operating at a speed of 225 r.p.m. under a steam pressure of 160 lb. at the throttle. Excitation for these generators is obtained from 2 100-v., 200-amp. Curtis turbine exciter sets running at 4500 r.p.m., one of which it is planned to replace by a motor-generator set of like capacity. In that event the steam-driven unit is to be used for starting purposes only.

A black-slate switchboard, made up of 3 generator, 1 exciter and 3 distribution panels provides means for the control of machines and feeders. Proper and close voltage regulation is maintained by a Tirrill regulator mounted on a bracket at the end of the board. Both synchronoscope and lamps are provided for synchronizing, the former being, however, the more generally employed.

Auxiliary electric equipment found in the engine room consists of a 10-kw., 440-v., primary, 60-cycle arc-light regulator supplying energy to a series tungsten system for yard lighting and a 25-kv.a., 440 to 110-v. transformer used in connection with the power house and round house lighting.

All generator leads are carried underground in fiber ducts laid in concrete and carried to a concrete trench

in the rear of the switchboard, whence they are distributed to their respective panels. Feeders are carried to the various departments in iron conduit.

A feature of importance but so often missing in isolated plants situated as is this one, is the provision which has been made for ample and proper illumination. By means of many large windows in the west and north walls of the room, aided by white walls and ceilings, sufficient and uniform distribution of light is obtained throughout the hours of day light, while 23 evenly-distributed lighting units, each consisting of a 100-watt tungsten lamp and Benjamin enameled reflector suspended 2 ft. from the ceiling, give all necessary illumination at night.

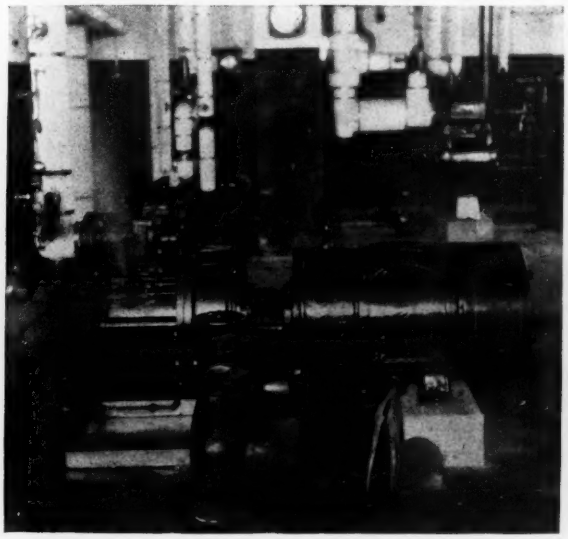


FIG. 4. ONE OF THE TURBINE-DRIVEN EXCITER UNITS

A bay to the engine room proper, contains an 18 by 10 by 12-in. Fairbanks-Morse Fire Pump rated at 1000 gal. per min. It is equipped with a Fisher automatic pump governor on the steam-supply line and a Crane tilting trap on the exhaust line. Adjacent to this pump is an 8 by 12 by 12-in. Marsh vacuum pump, draining 35,000 sq. ft. of radiation located about the storage departments, repair shops, round house and offices. The heating system utilizes exhaust steam only, the average pressure maintained being about 1 lb.

An employes' locker and power plant repair and supply storage room occupies the southeast corner of the engine room.

Steam-Generating Equipment

The boiler room which, as shown in Figs. 6 and 7, is an independent structure built of structural steel and brick adjoining the engine room on the Lincoln St. side, contains 4 Heine water-tube boilers built for 200 lb. working pressure and having 2649 sq. ft. of heating surface each. They are rated at 250 hp. and are equipped with Green chain-grate stokers, Green flat ignition arches and a Geco steam-jet ash conveyor. Each unit is provided with Crane nonreturn valves and a Hays differential draft gage connected to the first pass; steam-flow meters are to be installed on each boiler in the near future.

As the tracks of the storage yards and the roof of the boiler room are on practically the same grade, the question of coal delivery was readily solved. A spur track is run directly over the bunkers in the boiler room and the coal dumped therein. These bunkers, which have a capacity of 100 tons, are of unlined steel and are supported by cross beams built integral with the framework of the building. The coal is fed to the stoker hoppers through chutes attached to the bottom of the bunkers by chains, a form of construction eliminating a closed junction between chute and bunker, and giving ready access to the coal valve which is placed at that point, and is operated by a rod within ready reach of the fireman. The bunkers and chutes were built and installed by the Joliet Bridge and Iron Co., of Joliet, Ill.

All ashes are removed by the steam-jet conveyor referred to above. Upon being dumped from the grates at the rear of the furnace, the ashes fall into a concrete pit below from which they are raked into the suction of the system and delivered to a large capacity steel receiving tank on the roof of the boiler room. This tank, as shown in Fig. 7, is so located that as soon as a car containing coal has been unloaded, it can be filled

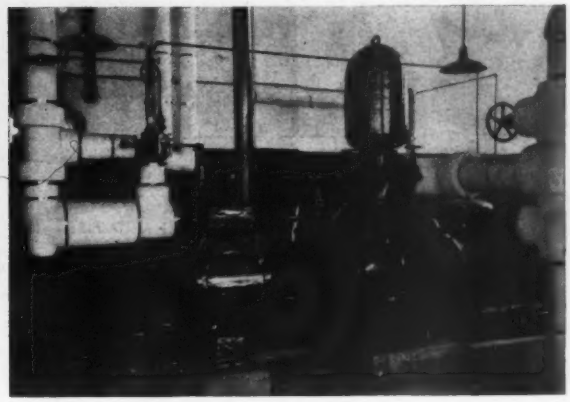


FIG. 5. AN EVER-READY SERVANT—FAIRBANKS-MORSE 1000-GAL. PER MIN. FIRE PUMP

with ashes before being taken away. This arrangement saves considerable switching about of cars and results in a continuous movement of the fuel from the time it is dumped out of the cars into the bunkers until it is again delivered to the cars as ash. All manual labor is thereby entirely eliminated.

In the ash-disposal system employed, the ashes are raked into openings in a pipe running along the fronts of the ash pits. As soon as the ashes enter these openings they are drawn into the pipe at a high velocity and discharged into the receiving tank on the roof of the boiler room.

Suction for creating air flow through the conveyor pipe is produced by a steam jet placed in an elbow in this pipe.

Water Supply

All water used for boiler feed in the power plant, in the locomotive-boiler fill system and for domestic purposes is taken from the city water mains, the quantity consumed being measured by a regulation water meter. For power plant boiler feed, the water is preheated in a Cochrane feed-water heater of sufficient capacity to care

for 1200 b.hp., or 200 hp. more than the normal rating of the boilers. From the heater the water flows by gravity to the suction of the boiler feed pumps, 2 10 by 6 by 10-in. Epping-Carpenter units of the outside-packed-plunger type, which discharge into a 4-in. looped feed line carried along the top of the boiler fronts. This line is provided with branch control valves having extended stems which allow their ready operation from the floor.

A 100,000-gal. steel tank, which is at all times maintained full insures a continuous supply of water should the city service become crippled for a short time for any reason.

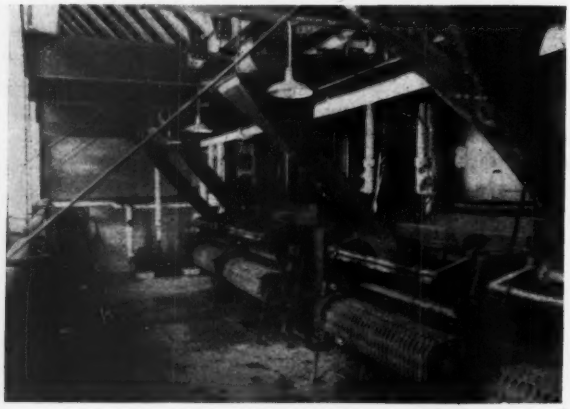


FIG. 6. THIS VIEW OF THE BOILER ROOM SHOWS THE GENERAL ARRANGEMENT OF THE STEAM GENERATING UNITS, THE CONSTRUCTION OF THE BUNKERS AND THE METHOD OF FEEDING STOKER HOPPERS

Blowoff from the various boilers discharges into a common header connected to a horizontal blowoff tank 3 ft. in diameter by 7 ft. long, located at the south end of the boiler room; from this tank the sediment sludge and water coming from the boilers is carried to a cooling basin and thence discharge into the city sewer.

Piping System

Crane valves and fittings, the latter including Crane lap joints on all high-pressure lines, are employed throughout.

The boilers feed through non-return valves into a single 12-in. header running along the rear of the boiler room. This header is then carried into the engine room where, after being tapped for pump supply and reduced to 10 in., it joins the engine header by means of an offset which allows for expansion and contraction.

Due to the layout of the plant, the boiler-room and engine-room headers lie perpendicular to one another with the result that a straight and rigid connection between the 2 would in no way provide for expansion and contraction. The line coming from the boiler room is therefore carried up to within approximately 6 ft. of the engine room header, where, by means of a 90-deg. ell it is turned and carried parallel to the latter up to a point opposite about the middle of its length. Here the 2 headers are joined and a suitable expansion joint thus provided.

All exhaust lines from air-compressor engines, generating units, exciter units and pumps enter a common 15-in. header carried in concrete trench below the engine-room floor and exhausting into the feed-water heater. Twelve, 6 and 4-in. branches are, however, taken off from this header for the steam heating, coach shed and locomotive boiler-wash and fill systems, respectively.

High-pressure, low-pressure and exhaust steam and hot-water lines are covered with Johns-Manville 85 per cent magnesia sectional covering which not only reduces radiation losses to a minimum, but also gives the installation a pleasing appearance. While this insulation is still of its natural or white color, as may be seen by the accompanying illustrations, it is intended to paint it, employing some color scheme whereby the operators may be able to tell at a glance whether any particular pipe is carrying high-pressure, low-pressure or exhaust steam or hot water.

Personnel

J. H. Davis, electrical engineer for the Baltimore and Ohio Railroad Co., was the designer of this plant, while O. B. Shaner, officially known as terminal engineer, was responsible for the installation of the equipment, and is now in personal charge of its operation.

FIG. 7. THE BOILER ROOM IS A SEPARATE BUILDING CONSTRUCTED OF STEEL AND RED BRICK; AFTER COAL IS UNLOADED, CARS ARE READY TO RECEIVE ASHES FROM STORAGE TANK ABOVE

Under him in turn are the various shift engineers, oilers, firemen, helpers and repair men. Each shift is manned by one engineer, one fireman, one oiler, and one helper and is 8 hr. in length, changes being made daily at 7:30 a.m., 3:30 and 11:30 p.m. In addition to the regular operators is also a repair man in charge of boiler washing and general repairs.

Observing neutrality in Switzerland is a problem seriously affecting the output of at least one power plant. Near Basle on the Rhine is a power house which furnishes electricity for a fort on the German side of the border. Swiss and German soldiers guard with utmost vigilance the amount of power transmitted across the border, the former to see that there is no increase, the latter to see that there is no reduction. We wonder who calibrates the meters.

Fire Fighting and Fire Prevention---III*

DETAILS OF THE SPRINKLER SYSTEM IN A MODERN LOFT BUILDING. BY FRANK WILLIAMS

THE general arrangement of the sprinkler system and piping is as follows:

From the gravity tank extending 4 in. above the bottom, is taken an 8-in. discharge pipe and dropped through the roof to the ceiling below, being supported from the steel tower to relieve the tank of any undue strains. In the horizontal section of this pipe is installed an 8-in. swing check valve and an outside screw-and-yoke pattern gate valve. The pressure tanks are each provided with 6-in. discharge outlets, the connections having a full sized gate and check valve in each and tie into an 8-in. header. An 8-in. pipe beneath the roof, cross connects these 2 water systems, thus supplying the so-called dead riser or stand pipe for the automatic sprinklers. The dead riser is of 8-in. steel pipe extending to the ceiling of the basement, and terminating with a horizontal check valve at the base.

On account of the ground area of the building it is divided into 2 sections, each being under separate control. Thus there are 2 6-in. live risers, one for the east section of the structure and one for the west section. An 8-in. header in the basement called the trunk main cross connects the dead riser with the live risers each of which is equipped, at the base, with a gate and constant pressure alarm valve. This main also receives the 3 fire department outside 4-in. siamese connections.

From the live risers, beyond the alarm valves, are taken connections for the sprinkling of the stairways, each connection being independently valved. The live risers extend the full height of the building and are the means of distributing the water throughout the entire system. At every floor, there is a valved connection taken for the live risers for the control of this supply in the mains and branch stringers of the sprinklers in each section of the building. All this piping is provided with a complete system of drips arranged for draining the water, if necessary, into the sewer. At every floor, the branch drip pipes are provided with gate and check valve, and at the head of the live risers, the drip is provided with a sight test glass.

The floors of the building are divided by the columns into bays of 14 by 19 ft., and on account of the beam setting, the ceilings have 3 panels in a bay, each 4 ft. 8 in. by 19 ft. Two lines of automatic sprinkler heads arranged to operate at 165 deg. F., are provided in each 19-ft. bay and spaced under the center of alternate 4-ft. 8-in. panels. In each end panel at the building walls, 2 heads are provided. The heads are all set parallel to the ceilings and follow the incline of the stairs. Elevator wells are equipped with sprinklers at the top of the shaft and heads are also set under decks or racks within dry rooms, vaults, etc., except for the engine room and the elevator motor rooms in the basement.

It is customary to arrange the deflectors of sprinkler heads from 6 to 8 in. below the ceiling; but in this building, on account of the overhanging beams forming the panels, the heads are set on some floors with the deflectors not over 2 in. above the underside of beams and on other floors from 2 to 4 in. below the under surface of the beams according to their depth and the nature of occupancy.

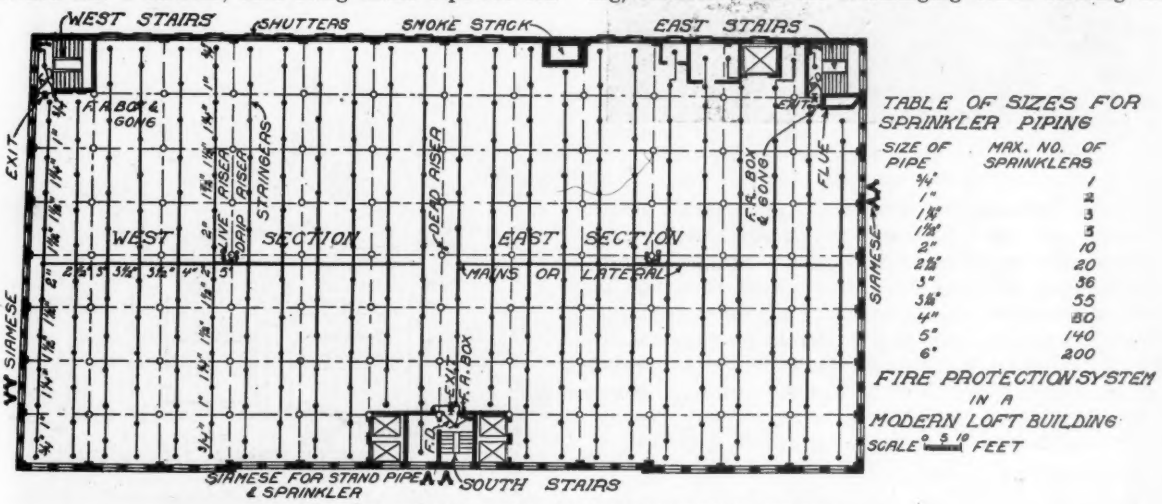


FIG. 1. TYPICAL FLOOR PLAN OF SPRINKLER SYSTEM

The valves on the live risers are, of course, near the ceiling, and in order to make them accessible, steps clamped to the pipe are provided for the full height, terminating with a safety ring at the top to give the inspector a bearing for his body.

The control valves used in the sprinkler system are outside-screw-and-yoke gate valves and fitted with iron body when over 2½-in. size, while those of 2 in. and smaller are composition valves. The valves in the supply pipes are secured open and so maintained by a wire with seal, whereas the drain valves are all sealed shut in a similar manner. Cardboard signs are provided for all valves, indicating the section of water supply controlled and these are securely attached to the body of the valve in a manner not to interfere with their operation.

*Continued from page 165 Feb. 1 issue.

In connection with the tanks, the sprinkler contractor furnished and installed all piping, valves and trimmings. From the house tank supply, a line is run for the filling connection to the gravity and pressure tanks. The supply for the gravity tank enters at the bottom and extends up to the top and there turns down

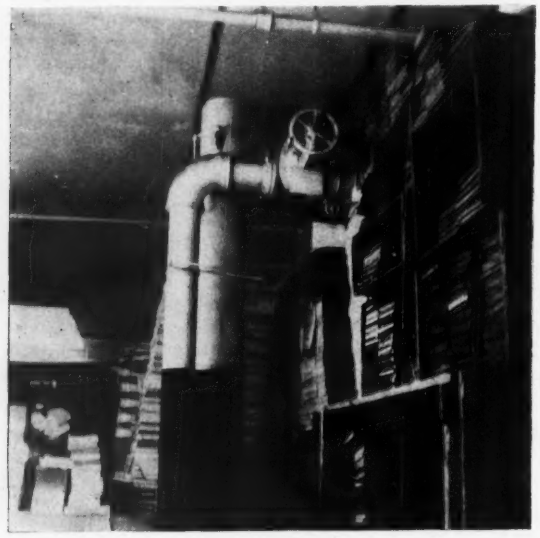


FIG. 2. LIVE RISER AND SPRINKLER PIPING

so water discharges into the tank; the overflow connection is also carried through the tank to the roof, together with the discharge pipe, all are wrapped into one nest, being insulated with frost proof covering; this also includes the steam and return piping supplying the 70 sq. ft. of 2-in. brass coil within the gravity tank.

To maintain the pressure tanks in proper working order, a steam driven air compressor with air storage

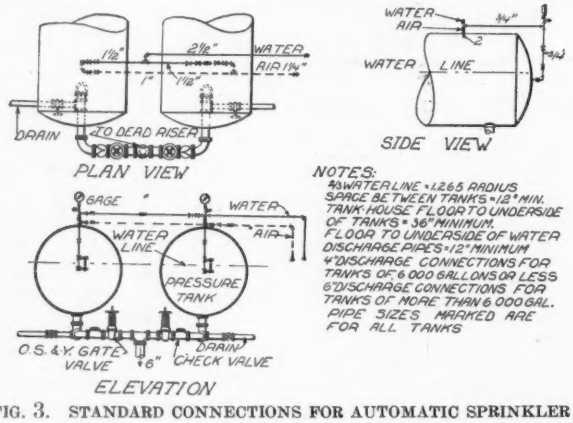

WATER
AIR
WATER LINE
DRAIN
TO DEAD RISER
PLAN VIEW
SIDE VIEW
GAGE
PRESSURE TANK
O.S.&Y. GATE VALVE
CHECK VALVE
ELEVATION
NOTES:
90 WATER LINE = 12.65 RADIUS
SPACE BETWEEN TANKS = 12" MIN.
TANK HOUSE FLOOR TO UNDERSIDE OF TANKS = 36" MINIMUM.
FLOOR TO UNDERSIDE OF WATER DISCHARGE PIPES = 12" MINIMUM
4" DISCHARGE CONNECTIONS FOR TANKS OF 6 000 GALLONS OR LESS
6" DISCHARGE CONNECTIONS FOR TANKS OF MORE THAN 6 000 GAL.
PIPE SIZES MARKED ARE FOR ALL TANKS

FIG. 3. STANDARD CONNECTIONS FOR AUTOMATIC SPRINKLER PRESSURE TANKS

tank is located in the engine room. This has a capacity of 30 cu. ft. free air per minute compressed to 75 lb. per sq. in., and is fully equipped with lubricator, valves, checks, gages, and steam and exhaust piping. From the air tank a 1¼-in. valve connection with check is carried to the pressure tank, and there the 1-in. branches are also provided with valves and checks where entering the tanks, and equipped with 6-in. dial spring pressure gages, having noncorrosive movements. To keep the water from freezing in the winter time, a 100-sq. ft. pipe coil radiator is set in the pent house.

A thorough alarm system completes the sprinkler installation under the contract and consists of a means for indicating high or low water in the gravity tank, high or low pressure in the pressure tanks, and flow of water in the alarm valves.

In each pressure tank is installed a double tube electric alarm for indicating the gage pressure on the dials, and for actuating the high and low points. In the gravity tank is installed a float switch to make contact for indicating high or low water. The alarm valves in the live risers are equipped with circuit closers and have double connections.

In the engine room is installed an annunciator with magnetic drops, controlled independently by switches, and each clearly marked. Over the annunciator is located an 8-in. gong to sound an alarm when any drop is actuated. A test key is also provided.

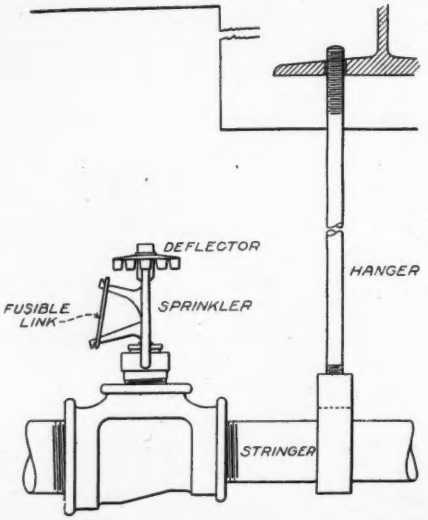


FIG. 4. DETAIL OF SPRINKLER HEAD SETTING

The electric current supply for this equipment is taken from a low tension switchboard erected as part of the sprinkler system, but it also serves the fire alarm and house circuits. This consists of a marbleized slate panel located in the engine room on the face of which are mounted the various knife switches and instruments, all the wiring being in back. Two dynamotors, transforming the house current of 250 v. to an operating pressure of 20 v., are mounted in front of the board for charging the 10 cells of storage battery which forms a duplicate current supply. The wiring arrangement is so flexible that one dynamotor may be charging the battery and the other supplying the circuits, or the battery may be feeding part of the circuits and one dynamotor supplying the remaining circuits. In case of a breakdown, either the battery or one of the dynamotors can handle the full load.

The complete sprinkler system installed, and as above described, comprising 3780 heads and also 6 spare sprinklers kept on hand for use in emergency, all the piping, connections, alarm system and the painting of all parts cost the total of $22,500. This figure includes the cost of monthly inspection of one year.

(To be continued.)

Turbines vs. Engines in Units of Small Capacities*

A Study of the Development of the Turbine for Various Services and Limitations of Turbine and Engine Units. By J. S. Barstow

THE term "units of small capacities" as used herein is intended to include steam turbines and engines of less than 500 hp. capacity. The paper will necessarily deal largely with the prime movers of auxiliary apparatus in power plants, since the tendency of the times in all industries, and particularly in central stations, is toward the concentration of power in a few units of large size and uniform capacity as opposed to a multiplicity of small units of different capacities. There is, however, a wide field for power application where the steam-operated prime movers are of relatively small size, and where transmitted or central station energy is not able successfully to compete; and it is intended to discuss the type of apparatus best suited in these cases, as well as the type of apparatus which it is advisable to employ for auxiliary units in large plants or central stations.

There are certain definite fields where the small turbine is of conceded superiority, and other fields where the engine must hold sway. The desirability of the one as compared with the other is largely determined by the following factors, which govern the adaptability, cost and economy of the equipment to be installed for any given service:

a Speed conditions and limitations involving consideration of maximum or minimum permissible speed, and whether the driven apparatus is of the constant or variable speed class.

b Steam pressure and temperature conditions involving consideration of initial and final pressures, and superheat, if any.

c Power capacity of apparatus.

d Relative space requirements of turbine and engine units involving consideration of available room, character of power house construction and cost of foundation or other supporting structure.

e Use or application, if any, of the exhaust steam for feed water heating, steam heating or process purposes.

f Available cooling water supply, if the turbine or engine is to run condensing, involving also consideration of the temperature of the water and whether it must be artificially cooled and re-circulated.

g Operating conditions including consideration of attendance, oiling, starting and stopping, vibration, noise, etc.

h Relative cost of complete installations including necessary foundations, piping and condenser equipment, if any.

As to the practicability of the small turbine, it may be said that not until about 20 yr. ago was any really practicable apparatus of this kind developed, and even up to 10 yr. ago the turbine was looked upon mainly as an experiment. The last few years have witnessed, however, the practical perfection of this type of prime mover in sizes as large as 50,000 hp., with units of 30,000 hp. quite common in large central stations. They have also seen quite as much good work done in the perfection of small turbine units as in the development of very large ones, and the turbine in all sizes is quite as well developed today as is the steam engine after more than 100 yr. of constant effort and improvement.

The writer has no intention of reflecting on the great work done by steam engineers in the development of the reciprocating steam engine. The work of these men, which was the harder task, accelerated the evolution of the turbine, the science of thermodynamics underlying the final development and perfection of both.

Present day builders of reciprocating engines are able to report further progress, however, and as a result of their recent efforts there have appeared the rejuvenated poppet valve engine adapted to the use of highly superheated steam; the unaflow or parallel-flow engine, also with poppet type valves, in which cylinder condensation is reduced by causing the steam to travel in one direction only; and the small self-contained power plant, or "locomobile," consisting of a steam engine mounted upon a tubular boiler and operating at high superheat. All these engines are adaptations from European practice, where, owing to the high cost of fuel and the relatively larger number of technically-trained operators, they have found high favor.

Mention also should be made of the power plant formerly used in the White motor car, which, owing to its high steam pressure, superheat and speed, gave remarkably low steam consumptions. In a series of tests, reported in the Transactions of the Society, the average steam consumption was 12.7 lb. per delivered hp.-hr., operating at 850 r.p.m.; steam at 275 lb.; superheat, 340 deg. F.; non-condensing exhaust.

Tests have recently been reported by the manufacturers which give the steam consumption of a 115 hp. Buckeye-mobile, running at 248 r.p.m.; steam at 210 lb.; initial superheat, 171 deg. F.; non-condensing, as 13.3 lb. per i.hp.-hr. This unit produced an i.hp.-hr. on 1.33 lb. of coal having a calorific value of 14,500 B.t.u. per lb. A 169-hp. unit running at 200 r.p.m.; steam at 209 lb.; initial superheat, 218 deg. F.; vacuum 25.7 in., showed a water rate of 9.2 lb. per i.hp.-hr. The coal consumption, using fuel with a calorific value of 14,209 B.t.u. per lb., was 1.08 lb. per i.hp.-hr.

While there is the possibility that the use of a shell type of boiler for high pressures will be considered by many engineers as unwise, especially for installation in densely populated centers, it is still too early to predict what the future of this apparatus is to be. However, as indicating what may be accomplished in fuel economy in a well-designed plant of small size, the results reported are interesting.

Speed Limitations

THE QUESTION of speed limitations is of first importance in selecting the type of prime mover. Since high peripheral velocities are necessary in order to utilize efficiently the energy of a steam jet in the turbine type of

*Paper read before the A. S. M. E.

apparatus, the latter shows its lowest water rate when running at a constant high speed. Where the character of the service is such as to require speed variation or reversal in direction, or where the speed is necessarily low, the turbine is unsuited and the engine is much better adapted.

In engine installations, the minimum permissible speed has an important bearing on the question of operation. If an engine is run at very high speeds, operating troubles are sure to be numerous, the upkeep excessive and the service unsatisfactory. The lack of driven apparatus designed to run efficiently at speeds consistent with high turbine economy has, in the past, frequently dictated the use of engine prime movers for many kinds of work.

Although speed reduction gears are by no means new, having been used with the turbine almost from the beginning of its commercial development, improvements in high speed gearing, as well as in the manufacture of high speed direct connected generators, blowers and pumps, running at 3000 r.p.m. and above, have greatly increased the possibilities for turbine installations. Direct current generators as small as 10 kw. capacity, and 60-cycle alternators of capacities as low as 150 kw., designed for gear drive, are now offered. The manufacturers claim for these machines that the increased efficiency of the higher speed turbine, together with the saving effected in the generator construction by reason of the slower speed permissible in the driven end, justify the expense and complication which the gears introduce.

While many may still prefer a direct connection, the increasing popularity of the gear drive, especially for direct current generators, blowers and pumps, would seem to indicate that the gears are here to stay, and that when properly constructed and installed, there is no valid objection to their use.

For power station work, where some of the auxiliaries are usually motor driven, the exhaust steam can be entirely condensed in the feed water heater, and the water rate of the steam driven auxiliaries is not a limiting factor, while reliability, accessibility, low maintenance and labor costs are of more vital importance. Power station designers have always exhibited, therefore, a strong preference for turbo-auxiliary units, and there is now a decided tendency toward geared installations.

The selection of turbines for auxiliaries is largely influenced by the high speed at which small engine units are run, which makes it exceedingly difficult to keep them in continuous service, and almost impossible to secure smooth, quiet operation. Such reciprocating units require close attention, and must be shut down, overhauled and adjusted at frequent intervals; the maintenance is high and serious breakdowns are by no means rare. An accident to a circulating or hot well pump, for example, usually necessitates a shutdown of the main generator, with consequent loss of production, and often, in the case of a public utilities plant, loss of prestige and the incurrence of public ill-will. In all central stations, therefore, where the main units are few in number and of large size, high economy as compared with continuous operation becomes relatively unimportant, and turbine driven circulating hot well and boiler feed pumps are almost invariably used.

Motor driven exciters are largely used in alternating current stations, a steam driven exciter being provided for starting up and as a reserve unit. Here also, since the steam driven set is idle a large part of the time, high economy is not so important and the saving of floor space and elimination of vibration will often decide the question in favor of the turbine. In fact, in all direct current generator sets of 50 kw. capacity or less, the high speed necessary for the engine generally makes it undesirable.

For driving fans of large capacity at low pressures, say less than 1½ in. of water, for induced draft, hot air heating and ventilating systems and the like, engines seem best suited. Fans built for this service ordinarily run at less than 200 r.p.m. and are usually of the paddle-wheel type, which is better suited to these conditions than the multi-blade high speed fan. In induced draft work, load fluctuations may require frequent changes in speed, the engine being under the control of a throttling regulator which is automatically actuated by a change of steam pressure. These conditions are quite unfavorable to turbine economy, and a suitably designed and well-constructed engine will give more satisfactory results.

In like manner, where we consider the pumping of large quantities of water against low variable heads (conditions which are encountered in drainage or sewage pumping stations) the turbine must yield place to its rival. These pumps may have single runners of large diameters or may be of the multi-impeller type, but in either case, the speed is below the economical turbine range, even when a gear is used, while the engine, at low speed, has an opportunity to make its best showing, steam economy and operating troubles considered. Where the lift is variable, speed changes are required and the engine is almost always more suitable.

As a typical installation may be mentioned the 4 76-in. centrifugal pumps for the Placquemine and Jefferson Drainage District of Louisiana. Here the pump speed varies from 50 r.p.m. for 1 ft. head and 135,000 gal. per min. to 115 r.p.m. for 13 ft. head and 90,000 gal. per min. The best duty was 92,600,000 ft. lb. per 1000 lb. of dry steam, corresponding to 21.4 lb. of steam per water horsepower obtained at 87 r.p.m. for 7 ft. head and 130,000 g.p.m. The prime mover is a compound engine operating at 170 lb. steam and 25.7 in. vacuum.

The use of underfeed stokers, operating under heavy forced draft and capable of developing high boiler ratings, has become quite common as a means of reducing fixed charges and boiler banking losses in railway and lighting plants, and particularly those maintained as standbys to hydro-electric stations. These furnaces often carry in the air duct pressures as high as 6 in. of water, and the high speed multi-blade fan makes the better installation, particularly where one fan serves several boilers, as the blower units frequently become excessively large when run slower than 400 r.p.m. At this speed the engine drive is an uncertain and expensive proposition.

Furthermore, as such stokers at best are capable of only from one-quarter to one-third their maximum capacity under natural draft conditions, a blower breakdown under a peak load is a serious matter and the ability of the turbine to stand up under the conditions imposed justly entitles it to the preference which it is accorded.

For driving directly connected alternators, a frequency of 25 cycles fixes the maximum speed at 1500 r.p.m., which is too low for the best turbine performance. In 60-cycle apparatus, where a speed of 3600 r.p.m. is possible, the turbine shows to better advantage.

STEAM PRESSURE AND TEMPERATURE CONDITIONS

THE HIGHLY economical steam turbine must necessarily be operated condensing, but, as previously pointed out, there are many cases where high steam economy is not the most important consideration and the non-condensing turbine often finds favor over the steam engine. One of the large heat losses incurred in the steam engine is that due to cylinder condensation and one of the common methods of reducing it is to limit the range of temperature through which the steam is allowed to work in a single cylinder. For this reason simple engines are better adapted for low steam pressures, while compound and triple expansion engines are advisable for high pressure and high temperature ranges, particularly if the load is uniform.

The engine as a rule develops mechanical troubles with high superheat, especially where the steam valves have much travel under unbalanced pressures. The consensus of opinion seems to be that for slide or gridiron valve gears, a temperature of 400 to 425 deg. F. should not be exceeded, while the best point for the Corliss type engine will be found below 450 deg. F. Above these limits lubrication is unsatisfactory and distortion of the parts is apt to give trouble.

In European practice, superheating is much more common than in this country, a superheater being considered quite as indispensable as a feed water heater and the poppet valve engine, which was first perfected abroad, is accordingly better suited for high superheat conditions than the type of gear commonly used in American engines.

A difficulty sometimes encountered with engines using high superheat is the warping of the cylinder, the curvature being caused by the higher temperature which prevails in the metal next to the steam chest. Precaution is taken by some builders to avoid such trouble by leading the steam by 2 independent pipes, entirely separate from the cylinder barrel, from the throttle directly to the steam valves.

For power plant auxiliaries, it would appear that turbines which experience little difficulty from high temperatures will be more and more widely adopted while engines will be less commonly used, especially so as steam pressures and superheats are constantly increasing, it being not unusual for new plants to be designed to carry from 200 to 225 lb. with superheats of 150 deg. F. and over. With steam engines running under high vacua, above 27 in., the great volume of steam to be handled increases the size of the engine cylinders, and the size of ports through which the steam must pass, to such an extent as to make the engines expensive if not of impracticable construction. The cost of an engine which would permit of complete expansion to such a terminal pressure, together with the increase in cylinder condensation, due to the greater range of temperature, would make the high vacuum undesirable.

The turbine, on the other hand, can be designed to operate on very low terminal pressures with comparatively slight increase of cost; its action as a heat machine is such that a greater expansion can be utilized and the economy is greatly improved by any increase in vacuum. When run non-condensing, as is well known, the turbine is less economical than the noncondensing engine.

In plants where the exhaust is atmospheric and cannot be applied to any useful purpose, the engine best fills the conditions, provided space is available and the speed may be made low enough to ensure smooth, quiet running. Such an application is found in direct current generator sets of 100 kw. capacity and larger, in hotels, office buildings and hospitals, where the exhaust is used for steam heating in winter and must be wasted for several months in the year. (To be continued.)

THE ANNUAL REPORT of the Director of the Bureau of Standards, Department of Commerce, gives an interesting account of the activities of that Bureau during the fiscal year 1915. The standards with which the Bureau has to deal are standards of measurement, standard values of constants, standards of quality, standards of mechanical performance and standards of practice. The relation of the Bureau's work to the public is clearly discussed, especially the Bureau's part in aiding industrial progress. During the year, 154,000 tests were made and 1,800,000 lamps inspected at the factories.

Color standards, the development of energy-measuring instruments sensitive enough to measure the heat of the stars, studies of the causes of failure of railway materials, exact determination of the data required in the refrigeration industries, and other important researches have made excellent progress during the year. An examination of the report shows that the year was the most active and successful in the history of the Bureau.

Of special public interest were the tests of railroad track scales, tests of parcel post scales, the work in methods of precision temperature measurement, with special reference to the refrigeration industries and the measurement of high temperatures and fire resisting properties of building materials.

Of particular interest to manufacturers and testing laboratories are the Bureau's investigations of industrial materials, such as metals, clay products, glass, cement, textiles, papers, rubber, and paints. The Bureau issued 47 new publications during the year, making a total of about 400 scientific and technical papers, circulars, and miscellaneous publications issued to date.

Of special interest to the people is the work of the Bureau in connection with public utilities, particularly in establishing definite standards of service, preparing safety rules, assisting in local studies as to service, acting as referee in cases of dispute and serving as a clearing house of information on all public utility and associated engineering questions, helping to secure uniform methods of accounting where public service commissions are not yet established, and getting out laboratory tests and investigations to answer difficult questions connected with the telephone, gas, electric light and power, electric railway transportation, and miscellaneous utilities other than steam railways. This work has met with great appreciation throughout the country.

SYDNEY, New So. Wales, is to have a new pumping equipment at Ultimo station consisting of 2 4000-g.p.m. units, centrifugal pumps and electric motors.

Power House Drainage

SHOWING HOW LACK OF FORETHOUGHT MAY RESULT IN CONSIDERABLE TROUBLE AND EXPENSE. BY G. H. KIMBALL

SOME years ago, a power house was built with the floor of the boiler room placed under a head of 2½ ft. of water, with no provision made for proper drainage.

A basement plan of the boiler room, engine room and pump room is shown in Fig. 1, in which a, a, a, is a drain 9 in. deep and 18 in. wide, running in the rear of the boilers to sump well S, in the pump room; D, D, D, are connections to this main drain coming from the engine room base through walls K and L. When steam was on, the sump well was drained by a pump automatically controlled and at other times by automatically operated water jet pumps.

On the opposite side of the boiler room was nothing to care for any water which might collect except pits E, B, and C, which were drained by a non-automatic water jet pump.

In the coal pocket the floor sloped from the level of the edge of pit E to points I, I, I.

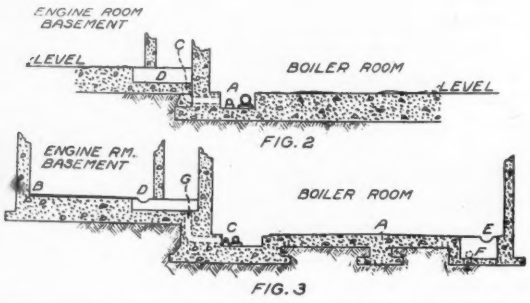


FIG. 2. ELEVATION OF FLOORS AND DRAINS AS ORIGINALLY INSTALLED

FIG. 3. ELEVATION OF IMPROVED ARRANGEMENT OF FLOORS AND DRAINS

In Fig. 2, an elevation of the floors and drains a, a, a, and D, D, D, is shown and it will be observed that there is no general slope, but a succession of hollows above and below a line running through them on a level. In this illustration, A is a cross section of the drain and shows the location of the pipes which, with their supports, were a serious impediment to the flow of water, and also tended to hold back all sediment. D shows how the drains are made in the engine room basement, part being rectangular in shape and part in the form of a pipe leading through the concrete.

In the pump room, Fig. 1, the sections around points H were low, and next to the drain and sump well points G were high, so that any water finding its way to these low sections remained there until evaporated.

J in Fig. 1 is the entrance to a subway leading to buildings supplied with power and light.

Due to some cause, the concrete floor cracked at points 1, 2, 3, and 4, Fig. 1, and although repaired several times, relief was but temporary. Points 1 and 2 being under the boiler and chimney, respectively, were extremely difficult places to repair, so a pipe was placed under the boiler to conduct the water from the crack into drain a. At point 3 a makeshift dam of cement and brick was made to keep the rest of the floor dry.

In Fig. 3, the floors are shown with some improvement in the drainage system. The engine room basement floor was made high at point B, with a 1-in. slope to the edge of gutter D which flows to drains D, D, D, Fig. 1.

The drain in the rear of the boiler room is shown in cross section at C, widened and with the pipes placed on the side nearest the wall. A drop of at least 2 in. from the boiler to the sump well, with no pockets as at point N, Fig. 1, was provided.

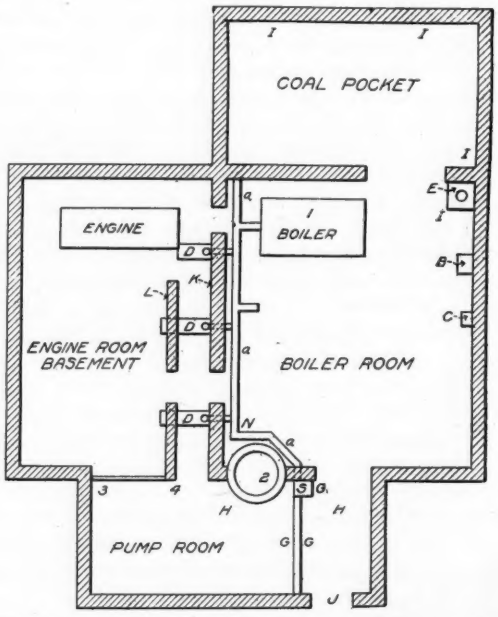


FIG. 1. BASEMENT PLAN OF ENGINE, BOILER AND PUMP ROOMS

Point A in the center of the boiler-room floor, was made 1 in. higher than the sides, sloping with no intervening hollows, to drain C and gutter E.

In the pump room the floor was sloped to sides 3 and 4, Fig. 1, and a gutter provided draining to the sump well. On the other side of drain G the floor was also sloped.

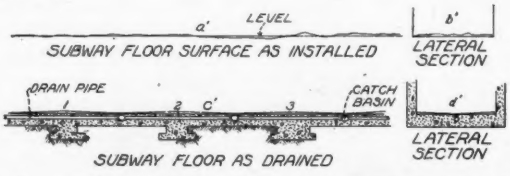


FIG. 4. SECTIONAL VIEWS OF SUBWAY BEFORE AND AFTER DRAINAGE SYSTEM WAS INSTALLED

In Fig. 4 are shown both lateral and longitudinal views of the subway floor as originally built and as afterward drained. The original arrangement was most unsatisfactory. At c' is shown how a pipe was laid in the concrete and catch basins placed at several points and the subway floor sloped as at d', which drained all accumulations of water and prevented further trouble.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Delta-Cross Connections of Transformers*

DESCRIPTION OF SCHEME OF CONNECTIONS ALLOWING PARALLEL OPERATION OF 2- AND 3-PHASE SYSTEMS. BY G. R. ROUX

IN THE merger and consolidation of electric properties into larger systems, the electrical engineer, in his task of rehabilitation and reorganization of the physical properties for more convenient and economical operation, often finds 2 generating plants that could be operated in parallel, but unfortunately, one has a 2-phase and the other a 3-phase generating equipment and distribution system.

The changing of either one of the systems to conform to the other involves considerable expense and a great deal of work and inconvenience, besides introducing some delay in completing the unification. It may also be desirable to supply the consolidated system from one plant and keep the other plant as a reserve or standby, at least for some time until the erecting of a central power plant is warranted.

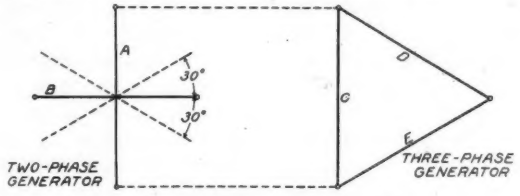


FIG. 1. ONE PHASE IN PARALLEL

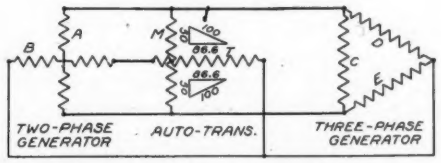


FIG. 2. PARALLELING 2-PHASE AND 3-PHASE THROUGH AUTO-TRANSFORMER

Under these conditions it is generally the practice to rewind the generators whenever this is feasible. This is quite an undertaking, usually interfering with the service, and is a useless expense if the rewound equipment is only temporary.

The parallel operation of 2-phase and 3-phase generators or of a 2-phase and a 3-phase system, or better yet, the simultaneous distribution through 4 wires of 2-phase and 3-phase energy, can be effected in a simple and economical manner, with no alteration or change in the mode of operation of the existing equipment, and at little expense.

*From a paper read before the A. I. E. E.

PARALLELING 2-PHASE AND 3-PHASE GENERATORS

IN THIS CASE we have 2 generators of the same voltage and frequency. Phase A of the 2-phase generator is in phase with phase C of the 3-phase generator, as shown in Fig. 1. These phases can therefore be connected to each other.

Phase B of the 2-phase generator is 30 deg. from phases D and E of the 3-phase generator, and it is necessary to swing this phase from 90 deg. phase A, 30 deg.

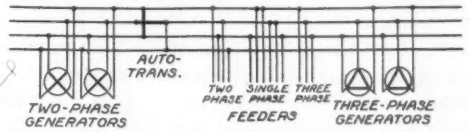


FIG. 3. PARALLEL OPERATION OF 2-PHASE AND 3-PHASE GENERATORS ON 4-WIRE DISTRIBUTION BUS, THROUGH AUTO-TRANSFORMER

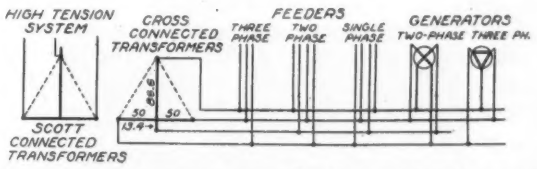


FIG. 4. PARALLEL OPERATION OF 3-PHASE INCOMING OR OUTGOING HIGH-TENSION LINE WITH 2-PHASE AND 3-PHASE GENERATORS ON 4-WIRE DISTRIBUTION BUS, THROUGH T-CROSS CONNECTED TRANSFORMERS

one way and 30 deg. the other—that is, make this phase oscillate to keep it in phase with the 2 other phases of the 3-phase generator.

To perform this operation automatically, we interpose between the generators an auto-transformer consisting of 2 transformers, M and T, each having a single winding, and connect systems as shown in Fig. 2.

Each transformer has a 100 per cent winding, the main transformer M, is provided with a 50 per cent tap, and the other, the teaser T, with an 86.6 per cent tap. They are not connected in T but in the form of a cross, with the 86.6 per cent tap of the teaser connected to the 50 per cent tap of the main.

The cross-connected auto-transformer will operate in the well-known manner of the Scott connected transformer for phase conversion from 2 phase to 3 phase,

and vice versa. The 13.4 per cent of the winding of the teaser operates as an auto booster to balance phase B, which otherwise would be short 13.4 per cent as only 86.6 per cent of its winding is utilized in phase conversion.

Figure 3 shows the 2 generators connected on a 4-wire busbar, to which single, 2- and 3-phase feeders are connected and can be fed, with either machine operating singly or both in parallel.

It is obvious that all phases are equally balanced, no matter which machine operates, as in the case of a Scott connection. The 2 machines can be located in the same engine room, or in different power houses some distance apart, their number and size being immaterial, provided they have the necessary characteristics for their operation in parallel.

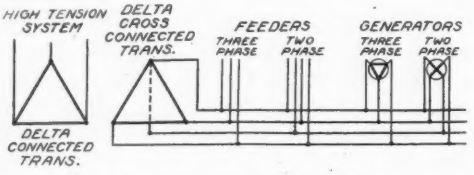


FIG. 5. PARALLEL OPERATION OF 3-PHASE INCOMING OR OUTGOING HIGH TENSION LINE WITH 2-PHASE AND 3-PHASE GENERATORS ON 4-WIRE DISTRIBUTION BUS, THROUGH DELTA

Quarter-phase machines (that is, 2-phase generators having their windings inter-connected) cannot be operated with this system, however, as the auto-transformer would short-circuit the phases.

Parallel Operation with High Tension System

For the parallel operation of a 2-phase and a 3-phase generating plant with a system of higher or lower potential, the 2-phase and 3-phase generators operating in parallel as in the above case, and at the same time in parallel with a system of different potential, 2 other styles of connections can be used:

T—Cross Connection

By the addition of a high-tension winding to the cross connected auto-transformers, as shown in Fig. 4, the 3 systems can be operated in perfect harmony and with a high degree of flexibility and independence. The diagram of Fig. 4 is also clear and simple enough, so requires no further explanation.

Delta—Cross Connection

Another system is still more convenient and advantageous. It consists of 3 transformers connected in closed delta, each transformer identical in size, windings and characteristics, and of a capacity corresponding to ⅓ of the requirements. No special taps need be provided except the usual 50 per cent taps to be brought out of one transformer only. The 3 transformers are connected in delta, as shown in Figs. 5 and 6, and a booster transformer having 13.4 per cent the capacity and voltage of one phase of the 2-phase system, is connected to the 50 per cent tap of one of the transformers, completing the delta-cross connection.

The 3 delta-connected transformers, Fig. 6, behave like Scott-connected transformers through the 50 per cent tap of the main, and both phases A B and A C are swung alternately 30 deg. around; A D, the phase resultant of A B and A C is 90 deg. to phase B C, but with a value of only 86.6 per cent of A B. Adding outside of the delta D E, 13.4 per cent of phase A B, makes phase A E of the same value in both voltage and capacity as each of the others.

The 13.4 per cent addition (whose capacity is only 6.7 per cent that of the bank) is made to B C by using an ordinary poletype transformer connected so as to boost to the proper value. Where potentials higher than 2300 v. are used in the 2-phase system, a booster transformer with better insulation is naturally required.

Two- and 3-phase current can be drawn from or put into the transformers connected in this style, and 2-phase and 3-phase generators both operated in parallel and with the high-tension system, with absolute security and flexibility without affecting the operation of any part of the system.

Figure 5 shows the practical operating conditions of such a system that has been in operation for 4 years with complete satisfaction, which consists of 3 500-kv.a.,

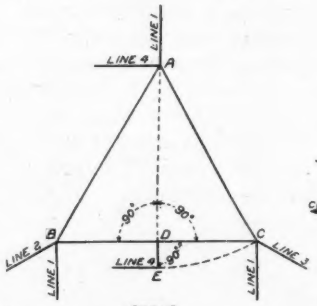


FIG. 6

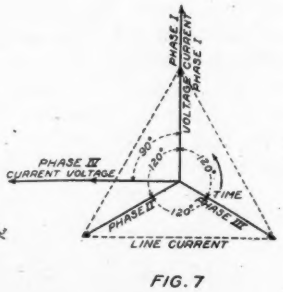


FIG. 7

FIG. 6. DELTA-CROSS TRANSFORMER CONNECTION
FIG. 7. PHASE, VOLTAGE AND CURRENT RELATION OF 2 AND 3-PHASE SYSTEMS

6600/2300-v. transformers connected delta-cross. Another installation with 3 100-kw., 6600/2300-v. transformers connected delta-cross has been operating under similar conditions for 3 years, paralleling 2 generators 2 miles apart. The 2-phase generator has been replaced lately by a 3-phase machine of a larger capacity, and the 2-phase apparatus on the line has also been changed to 3-phase. The 3 100-kw. transformers have been kept in the plant and the only change made was the removal of the cross of the delta—that is, the small booster transformer, as there was no further use for the 2-phase current.

Three 2-phase systems each 120 deg. apart, and one 3-phase system, could be supplied through this style of connection requiring only 6 wires, as illustrated in Fig. 6, with each phase 60 deg. apart; that is, a 6-phase system could be supplied and sub-divided again into 6 phases, making a 12-phase system, each with a 30 deg. angle difference.

The removal of one of the 2 teaser transformers of Fig. 5—that is, operating in open delta—would not interfere with the 2-phase transformation, except that the capacity of the bank of transformers would be reduced correspondingly.

Should the 2-phase system be abandoned later, the booster transformer can be removed and the bank operated closed delta in the ordinary way.

The diagrams of Figs. 6 and 7 show the principle of the transformation of 3-phase to 2-phase. The current of the teasers instead of coming to the middle of the main, enters the ends and leaves at the middle. A phase displacement of 30 deg. is effected, or from 120 to 90 deg. The phase so displaced, although having the proper angle, has not its original voltage value but only that of cosine of 30 deg. The complement is made through the booster transformer and is in phase with the phase boosted.

The 3-phase currents are not displaced or affected in any way. It is evident that the current circulates in the windings and distributes itself automatically according to the resistance of the exterior circuits, that is of the 2-phase and the 3-phase system.

The applications of the systems of transformer connections described above, are practically unlimited, whether for permanent or temporary installations.

In the case of an isolated power plant supplying a 2-phase system of distribution and later fed from a 3-phase transmission line system, no changes are required to the existing local distribution system; and yet it can be gradually changed into a 3-phase system, all new motor installations being 3-phase. The motors of the old installations when replaced at any later time, can be changed to 3-phase. The 2-phase local generating plant can be operated any time without interfering in the least with the operation of the entire system.

A 2-phase and a 3-phase installation can be fed from one bank of transformers simultaneously, without mutual inconvenience. The 86.6 per cent tap on T- or Scott-connected transformers, can also be eliminated, as it is often found difficult to provide for a tap of this value, which somewhat affects the internal stress of the transformer, while a 50 per cent tap is not objectionable. The eliminated complement of the 86.6 per cent tap can be compensated outside of the transformer, so that one transformer has a 100 per cent winding and the other 115.5 per cent, thus restoring equilibrium in phase value.

The theory of the phase transformation which takes place in a system of transformers connected cross-delta, as shown in Fig. 6, is in a way similar to the dephasing action in T-connected transformers. The 2-phase system is interlocked with the 3-phase system, through one of their respective phases, which are in phase with each other.

Tool for Inserting and Removing Enclosed Fuses

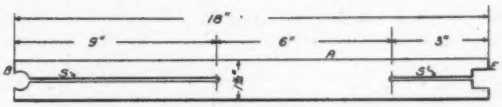
By Karl Hoffman

IN the accompanying figure is illustrated a convenient tool which may be used for inserting and removing enclosed fuses located in inaccessible places or where the man who is doing such work is subject to severe shocks by coming into direct contact with the fuses.

This tool, which may easily be made by any one, consists of a strip of dry wood 1½ by ½ by 18 in. The hole at the end of the strip is first bored to fit the required size of fuse and is then sawed off as shown. By means of a rip saw, a slot is then cut back to a small hole located at about 9 in. from the opening for the fuse.

When removing a fuse, the tool is grasped at A, pushed against the fuse causing the end of the tool to spread and snap around it. By moving the hand toward end B, pressing the 2 parts together, the fuse may readily be removed.

End E, provided with a square slot a trifle less in width than the diameter of the fuse, may be used for the insertion of fuses. Space S′ is not cut back as far as S, being but 3 in. long. This is done so that the fuse may with ease be held in the slot and inserted in the fuse holder, after which the tool may be withdrawn with but a slight pull.



HANDY TOOL FOR INSERTING AND REMOVING ENCLOSED FUSES

If the sizes of the fuses are not greater than 30 amp., one tool will be sufficient; but above this size, the bodies are larger and it will be necessary to make the tool accordingly.

When not in use, this tool should be kept in a dry place.

Toughness of Tungsten

By L. M. Johnson

THE accompanying illustration shows the filament of a 100-w. tungsten lamp that continued to burn after the glass center post was broken off and had fallen to the bottom of the bulb, carrying one loop of the filament with it. The lamp had been burning in this condition for 2 weeks when the photograph was taken

PHOTOGRAPH OF TUNGSTEN LAMP FILAMENT SHOWING ONE LOOP AT BOTTOM OF BULB

and for the purpose was removed from its original place and suspended from an extension cord while the exposure was being made. It was then returned to its original place where it continued to burn until some time later, when due to being accidentally hit the filament was broken.

Engine Trouble

WHY SHE BANGED AT EACH END AND GRUNTED IN THE MIDDLE; AND WHY SHE STOPPED IT. BY R. A. CULTRA

ONE quiet, hazy fall afternoon, with the force all alert on the job, the generators droning cheerily, and the sniff-sniff of the exhaust sifting in through the window with the lazy sunshine, the call of the road came to me, and slipping a couple of Practical Engineers into my pocket, I took the train for a suburb where a few small mills were sending the smoke laws all to the bad.

Locating one engineer, I queried as to his liking for an article in the last issue that I had found particularly interesting, on new methods of boiler operation.

"Nope. Been too busy 'round the factory to fuss with the boilers; got all I can do to run the engine."

"But don't you know the boiler plant is where you can save most money, as that article shows?"

"Got no time to read papers if I had 'em, so what good would they be to me?"

This promised little of enjoyment or instruction in further talk, so I pointed to a big stack across a tract of woodland which was aglow with yellow and crimson and inquired, "Big mills over there?"

"Well, there's a big plant t'other side those woods, but I don't think they're running. Heard they had engine trouble."

"Been over there lately? Do they allow visitors?"

"Oh, they're kind of fussy about visitors, but I guess you can get in. I understand they got quite a big engine now, but I haven't been over. Been here only about 10 months and have so much overtime I can't go anywhere."

"Well," said I, "I hope you get things straightened out so you won't have so much overtime and can get around some. And you'd better find time to read those Practical Engineer boiler articles. Might help to cut down the overtime work. So long."

The big stack looked substantial and promising of interesting things allied, but what can delight one who for a time is free from the daily responsibilities more than a vagrant old lane, shaded with the gorgeousness of King Autumn's canopy and dotted underfoot with blotches of dancing sunlight, splotches of purpling sumac and masses of asters and goldenrod?

But, even with dallying to watch the birds and the cloud drift, and to glory in the whisper of leaves and the gabbling of the brook, the big plant was presently before me, and stepping through the engine room door, the familiar smells and sounds brought the engineer's sixth sense to life again.

There was the engineer with a helper evidently just finishing putting on the cylinder head of a 24 by 48-in. old type Brown engine. We passed the common greetings and then:

"Been 'takin' of her down and puttin' of her up' a little, I see."

"Yes, and it's the third time up, too. We're just getting ready to try her again. She pounds like blazes, and I can't find the hammer."

"Well, there's nothing like trying. Let's see her go."

Steam valve slightly cracked; easy she starts; over once o.k.; over she goes a—Bang! Just as she turned the head end center on the second revolution. Bump! After the crank passed the crank end center. Snap shut the engineer sent the throttle, then walked around to where I was, and seeing the journals in my pocket, said: "Are you one of those mechanical paper fellows who write things upon engineering?"

"Yes."

"Well, you're the first one who has come into this place in the last 2 yr. and if you can tell me anything about what makes this old casting slam so, I'll be mighty glad you came. If I don't get her to going pretty soon, I expect to be going myself, for the boss is getting mad. I've had her stopped 2 days now, and I certainly don't want her stopped 2 more.

"Well, dig up some overalls, and I'll give you a lift. We'll see if we can find what's ailing her."

While we got and got into the required uniform, I asked,—he answered,—and I studied the position and condition of parts as we talked.

It seemed he had tried to put in a new set of crosshead babbits, and as the top ones were put in first, the new ones would not fit on the bottom, so the old ones from the top were put on the bottom, which left some play between the crosshead and guides. As the adjusting bolt was stuck fast, he had made a practice of changing the shoes when they became badly worn, also had packed the piston rod with good hard asbestos packing, since the packing always wore out quickly.

We started her again slowly, and, as the noise didn't seem to be fatal or even disastrous, I let her turn and listened to the various pounds and occasional grunts, trying to see where and why; but I was considerably puzzled by the weird combination, which seemed to come from both ends, and the middle all at once.

As the symptoms were not conclusive, we stopped her and started a still hunt for the cause of the racket.

The first thing was to loosen the much abused wedge adjusting bolt, which was supposed to raise the crosshead, by the left-hand thread pushing the wedge back. Somebody had turned it to the right so strenuously as to batter the head beyond the powers of a wrench, and had thus brought the wedge up hard against the shoulder, so that it could not be used.

By dint of a stilson and persuasion the bolt was finally started free, and the head filed true so that a wrench was again usable on it. The new shoes were removed from the top of the crosshead to the bottom, and the old ones, which were still in good condition put on top, but as the guides were somewhat worn, 2 1/16-in. shims were put on the bottom between the shoe and the babbit, to allow for more adjustment by the wedge.

Comparing the old shoes from the bottom with the thickness of the new ones plus the 1/16-in. shims, and the wedge screw set up a turn and a quarter, it was a safe bet that the crosshead had been down some 3/16 in., and this was not all.

"That crosshead pin has a measly way of working the nut loose," said the engineer, "and then she wabbles worse."

So out came the pin, the brasses were trued up as best we could with the tools at hand, and replaced, and

the pin put back, turned a quarter over. Then the nut on the head was slackened one turn, and we screwed up on the pulling nut, putting a 3-ft. bar under the ¾-in. lever used to turn up the nut. This compound pry pulled the nut on the smaller end of the pin up tight, drawing the pin into the crosshead solid beyond the possibility of a wabble, and the nut on the head was then drawn up to make all snug.

We tested and adjusted for height between the guides, took off the cylinder head, and raised the piston about ⅛ in. by the junk ring, then put all back in shape and drew a long breath.

"Well, if my idea is right, she goes now," said I.

"Yes," said he, "but why?"

"Why, the crosshead and piston were down, and the whole thing rode on that rod packing except at the ends of the stroke when she teetered. First the piston banged down at the head end against the cylinder, then the crosshead bumped down at the crank end against the guides, and repeat so on."

"Well, we thought of everything else," said he. "We were sure something had happened to the piston. First we hunted loose follower bolts, but they were all solid, and then we hunted for bolts that had bottomed, leaving the follower plate and junk ring loose. But we didn't get any idea that those crosshead shoes were raising the dickens."

"No? Maybe I'm wrong, but I think she teetered, on account of that bottom play of piston and crosshead, the hard packing and those loose pin boxes. Anyway, let's see what."

Steam on easy again and she turns as quiet as a kitten chasing its tail; over and over, and not a bump.

"You're right. She teetered. And I never could key her up right before or she'd pound the guides until they rattled. Say! did you get that idea from those papers?"

"Well, I get all kinds of ideas from everywhere out of that paper, and I store them away for future use, and mix in common sense to see where the ideas fit."

"I've been in this plant more years than I can remember, and I thought I knew every kink of every machine. But I guess I'll have to begin to read up and get new kinks from other plants, too. Looks like I don't know it all yet."

A hard afternoon's work for 4 men, but that engine was rolling as sweetly as a new one on the test block.

As we washed up the Super came in and said, "She's certainly all right now. How did you find the trouble?"

The chief looked at me, grinned and said, "I've been getting ideas from reading by proxy." Then he introduced me and explained what we had done; and the Super handed me his compliments and an urgent invitation to supper and spend the evening. But I explained that I had a family waiting and a plant to start up in the morning and must hustle to catch the train.

That mile and a half of woods was still red and gold and purple, but I thought as I ran for the station, "It's a pleasant thing to dally with nature, but it's quite as good fun sometimes to 'make the wheels go round' and to help the other fellow out of a hole when he's stuck."

The Thinker

By Berton Braley

BACK of the beating hammer
By which the steel is wrought,
Back of the workshop's clamor
The seeker may find the Thought.
The Thought that is ever master
Of iron and steam and steel,
That rises above disaster
And tramples it under heel.

The drudge may fret and tinker,
Or labor with lusty blows,
But back of him stands the Thinker,
The clear-eyed man who Knows;
For into each plow or sabre,
Each piece and part and whole,
Must go the Brains of Labor
Which gives the work a soul.

Back of the motor's humming,
Back of the belts that sing,
Back of the hammer's drumming,
Back of the cranes that swing,
There is the Eye which scans them,
Watching through stress and strain,
There is the Mind which plans them—
Back of the brawn, the Brain.

Might of the roaring boiler,
Force of the engine's thrust,
Strength of the sweating toiler,
Greatly in these we trust.
But back of them stands the Schemer,
The Thinker who drives things through;
Back of the Job—the Dreamer,
Who's making the dream come true.

National Gas Engine Association has been using various data sheets which are of assistance to those handling, and particularly selling, gas and gasoline engines. Volume I of the sheets, which are in loose leaf form, gives various standards and engineering data of help to gas engine men. Volume II gives figures in regard to cutting of ensilage, the capacity of silos, and the power required for handling the ensilage cutters and conveyors. Volume III gives data on feed grinders, shellers, etc., including capacity, speed and power required. Volume IV gives similar information on hay presses, and Volume V on Power Pumps gives lift, head, efficiency and the explanation of different types of pumps. Volume VI, which will be ready shortly, is on electric outfits, giving data sheets on electric generators, motors, switchboards, batteries, etc., and also methods of figuring wire sizes for lighting and power circuits. Volume VII, to appear later, will give information on creamery equipment, and the power required for it. Other sets of sheets are under preparation.

The Association is growing rapidly, and many prominent engineers and engine building firms have recently become members.

Bear-Trap Weirs on the Ohio Rivers

CONSTRUCTION OF BEAR-TRAP WEIRS, DETAILS OF DEVELOPMENT. BY A. P. CONNOR

BEAR-TRAP weirs may be called adjustable weirs without any mechanism to perform directly the functions of adjustment. They are further hydraulically operated weirs in which the only containing parts for the water are the flat sides of the weir. They may be like a bear-trap, but as there is not a great deal of the sport in which they would be used, it is hard to confirm the similarity inferred by the name.

In the particular case, where the weirs in question are used, that is, on the Ohio River, severe conditions have to be met. The Ohio River has a great characteristic of flooding, or in other words of sending great quantities of water down the river, at short notice. At certain points on this river dams are provided to keep a sufficient depth of water at all times for navigation. In other words, the river is divided into sections by the use of dams, that serve to make it a series of pools or lakes of restricted width. When a flood occurs, some means has to be provided for allowing the surplus of water added to the river, to pass off without affecting the established depth of the river. This is done by means of weirs, which are made adjustable according to the amount of water to be allowed to run off. This arrangement keeps conditions stable enough for the navigation purposes. At certain seasons when the water is excessively abundant on this river, the dams themselves are laid low, their construction being designed to permit it. In such cases, the weir can be used in any way seen fit; that is, it may be lowered or raised, as its action would have little effect on the flow of river at those times, due to its small size in comparison to the width of the river.

There are in general 2 types of bear-trap weirs, one having 2 main leaves, and the other having 3 main leaves. The first is the older type, and has been found to be the most satisfactory on the Ohio River. The advantages claimed of the second type over the first are that it requires less head to operate it and in some cases it is cheaper to install. In practice they have entailed a great deal of trouble owing to their not working and standing the stresses properly. Of course, at a later date this type may prove itself better, but it is not looked upon as more satisfactory at this time.

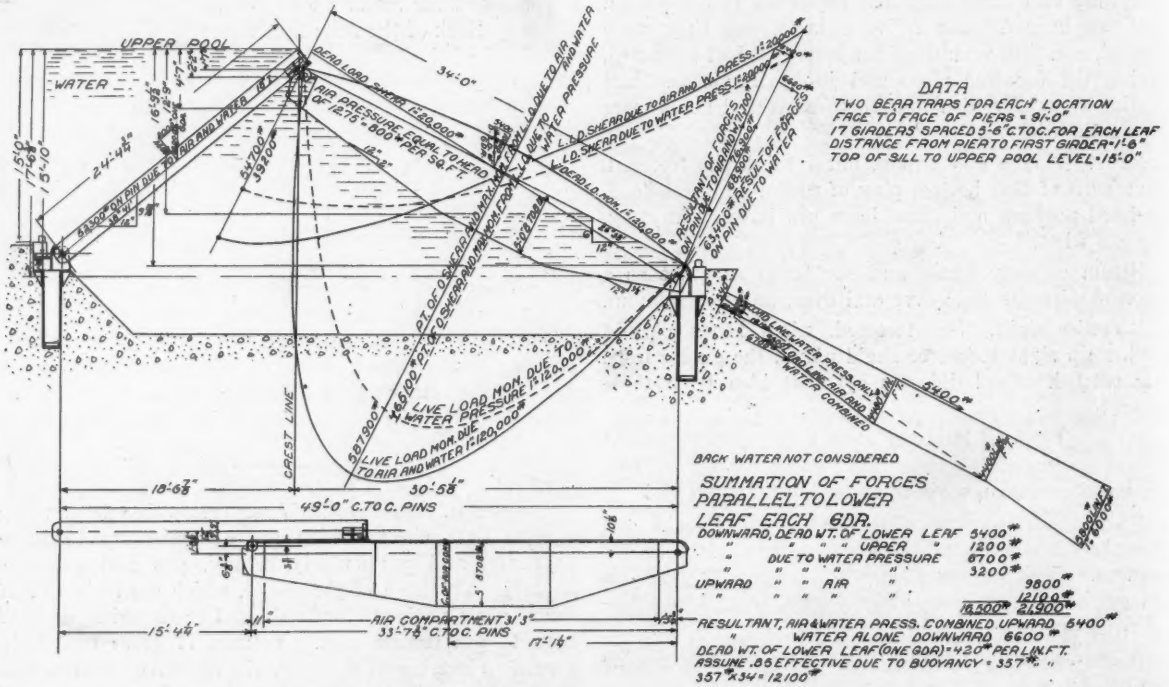

UPPER POOL
WATER
DEAD LOAD SHEAR 1:80,000#
AIR PRESSURE EQUAL TO HEAD OF 12.75 = 800 # PER SQ. FT.
L.L. SHEAR DUE TO AIR AND WATER PRESSURE
L.L. SHEAR DUE TO WATER PRESS. 1:60,000#
34'-0"
DATA
TWO BEAR TRAPS FOR EACH LOCATION
FACE TO FACE OF PIERS = 91'-0"
17 GIRDERS SPACED 5'-6" C. TO C. FOR EACH LEAF
DISTANCE FROM PIER TO FIRST GIRDER = 1'-6"
TOP OF SILL TO UPPER POOL LEVEL = 15'-0"
LIVE LOAD MOM. DUE TO WATER PRESSURE 1:120,000#
LIVE LOAD MOM. DUE TO AIR AND WATER 1:120,000#
CREST LINE
BACK WATER NOT CONSIDERED
SUMMATION OF FORCES PARALLEL TO LOWER LEAF EACH GDR.
DOWNWARD, DEAD WT. OF LOWER LEAF 5400#
" " " " UPPER " 1200#
" DUE TO WATER PRESSURE 6700#
" " " " " 3200#
UPWARD " " AIR " 9800#
" " " " " 1210 0#
16,500# 21,900#
RESULTANT, AIR & WATER PRESS. COMBINED UPWARD 5400#
" WATER ALONE DOWNWARD 6600#
DEAD WT. OF LOWER LEAF (ONE GDR) = 420# PER L.N.FT.
ASSUME .85 EFFECTIVE DUE TO BUOYANCY = 357#
357 X 34 = 12100#
49'-0" C. TO C. PINS
AIR COMPARTMENT 31'-3"
33'-7½" C. TO C. PINS

FIG. 1. DETAIL AND DIAGRAM OF BEAR-TRAP WEIR

In Fig. 1 is shown a diagrammatic view of a bear-trap dam, as well as reference to matters of stresses which are self-explanatory. It will be seen that it consists of 2 leaves butting against each other in tent fashion. The smaller leaf is always on top of the larger, and is the one that holds back the water upstream. The larger and lower leaf, or gate as it is sometimes called, is arranged to support the smaller like a prop. As the latter bears the greater part of the stresses, it is made more substantial than the former. The plates on the leaves run back on the girders so as to obstruct the space where they are situated between the weir walls. The girders of the lower leaf are arranged with holes in them to per-

mit water and air to flow through them when they are flat on their floor bed. Figure 2 shows the lower leaf, covered with plating.

The leaves are hinged at one end to the floor of the weir space with suitable sills behind the hinges to keep down leakage. Plates are placed on the sills and make a kind of socket joint over the hinge, which serves further to decrease the leakage and to protect the hinges.

The lower leaf is provided with wheels or rollers which run on the simple I-beam girders of the upper leaf, so that the sliding frictional resistance is reduced. The lower leaf also is provided with a curved projection which is adapted to catch a part of the upper plate when it reaches the highest desirable raised position, and thus prevent the plates from becoming detached from each other and rendered inoperative.

Walls and floor of the weirs are made of concrete, and are arranged with ducts for the water to pass to the weir proper in order to operate it. One main duct

FIG. 2. VIEW OF THE CONSTRUCTION OF THE UPSTREAM GATE OF A BEAR-TRAP WEIR

runs through the wall on each side with an inlet to it at the upstream end and an outlet at the downstream end. In the middle portion of the wall and in line with the space under the weir plates, are a series of openings, such as may be seen in Fig. 3, each inlet or outlet, as the case may be, being provided with a butterfly valve, similar to a damper used on furnace flues. Its great feature is in its simplicity and suitability for the work.

The weir depends on the working of the valves for its operation, and their action is interesting. If the weir gates or plates are to be let down, all water flowing under them is stopped. The plates having nothing to keep them up, go flat.

This stoppage of water is caused by shutting the inlet valves in the middle of the wall. If it is desired to raise the plates, the inlet valves are opened, and at the same time the outlet valves at the downstream end of the ducts in the walls are closed, either partly or in full, depending on exigencies. The water then flows with force under the leaves and lifts them, the height to which they are raised depending on the amount of pressure and water going under the leaves. This pressure and amount is controlled by the opening and closing of the 2 end sets of valves.

After the weir leaves have been unused for some time, they become a little stiff to work, and in such a case, the water pressure may not be sufficient to operate them. In order to meet this condition, compressed air is forced in with the water under the leaves, at a high enough pressure to start them upward, and after the start there

FIG. 3. DOWNSTREAM PLATE SHOWING GIRDERS DURING CONSTRUCTION

is usually no difficulty in getting the leaves to work properly. It is only in very unusual cases, that the head of water behind the weir is insufficient to raise it, these exceptional cases being due to some heavy deposit of silt or like condition. Air, however, is always on hand at these projects to act in emergency. The air compressors are run by turbines operated by the small head of

FIG. 4. DETAIL VIEW OF A LOCK WALL POWER HOUSE, SHOWING OUTLETS AND INLETS OF DUCTS TO TURBINES

the river, and are placed in small rooms provided in the lock walls of the project. In Fig. 4 is shown the outside appearance of the station; the small head may be noted by the position of the inlet and outlet holes. The appearance of the weir in operation is indicated in Fig. 5 to the left of the picture. The picture gives a good idea as to the quantity of water that it can control.

The bear-traps are about 91 ft. long between weir walls or piers, and in general cases the distance from the top of the sill to the upper pool level is 15 ft.

The floor of the weir space is recessed as indicated in Fig. 1, to permit the weir plates to lie flat on the bottom of the bed. The weir works with ease, in spite of its great collective weight, and usually no trouble is experienced in its operation. The leaves are installed in sets of 2 in usual locations on the Ohio River, in order not to have them too long, as the limit desired in length is about 90 ft. The number of the weirs can be, however, and is, varied according to the location.

In the actual operation of the weirs, telephone communication is set up between the different points of the river and warning is given at appropriate times as to the condition of the river farther up, and what is to be expected. The tenders at the weirs then make necessary preparations accordingly, and everything is taken care of like clockwork.

Incidentally it may be mentioned, as well as seen, that the water power possibilities of the Ohio River are enormous, and that they could be readily utilized and without great expense, as the U. S. Army Engineers have already provided everything required in the way of dams. When Congress sees fit to pass a law permitting the use of the river for power purposes it is expected that the greater part of the river will be rendered available to enormous projects of this kind.

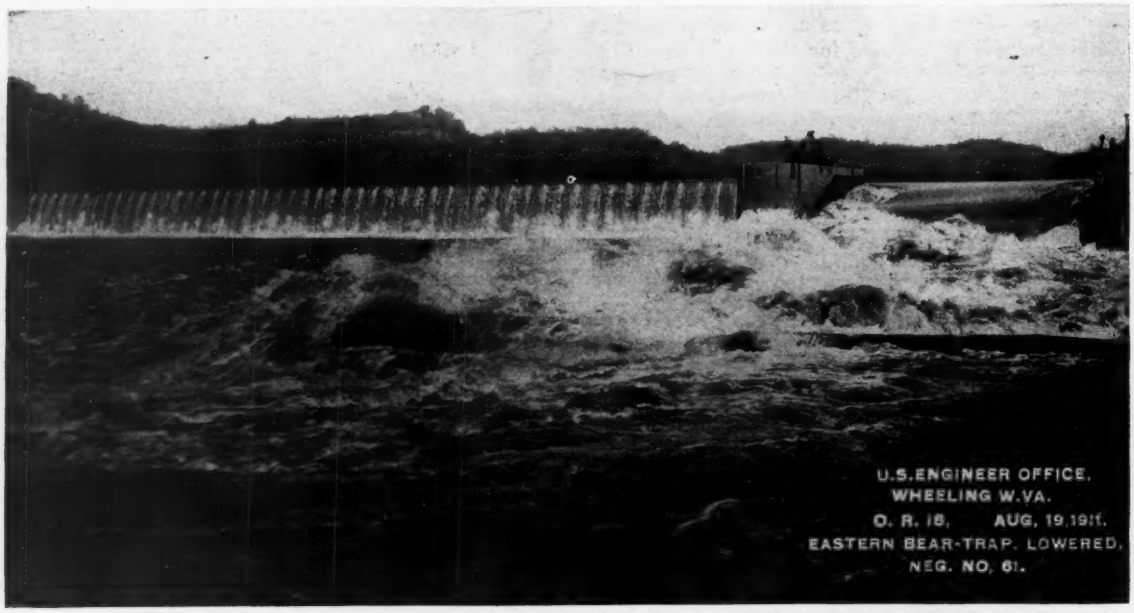


FIG. 5. LARGE BEAR-TRAP WEIR IN OPERATION, AT THE RIGHT

THE WATER, LIGHT AND POWER company of San Domingo started service of water and electricity in Santiago de los Caballeros on Dec. 11, 1915. This is the largest city in its province, having a population of 15,000. Electricity has been supplied by the same company to Puerto Plata since 1913 and extensions are planned to Moca, La Vega, and San Francisco de Macoris. U. S. A. capital is back of the company which is represented here by Moore & Co., of Boston.—Commerce Reports.

Cement and Concrete

By J. C. HAWKINS

THE field of building and engineering has arrived at the point where concrete plays one of the most important parts in construction. In years past, it would have been impossible to perform the feats in engineering that are of common occurrence today, without its use.

Portland cement, which is one of the principal ingredients of concrete, dates back to its first period of manufacture in England in 1824, when John Aspdin, a bricklayer in Leeds, invented the product by simply burning a mixture of limestone and clay with subsequent grinding, calling the mixture Portland cement, from its similarity to the famous stone of that name in England. His method of manufacture was different from that of the present day only in the process of manufacture. Wood rots, steel rusts; but cement, like the hills, lasts forever.

Portland cement is a complex substance whose essential elements are lime, magnesia, silica, alumina and iron oxides in combination one with the other, the physical properties of which are governed by the relative quantities of these elements. Briefly, its process of manufacture is that the raw material, carbonate of lime, as limestone, marl, chalk, etc., and aluminum silicate in the form of clay, shale, cement rock, etc. in conjugation with gypsum or sulphate of lime, are ground to a fine powder, then calcined at a very high temperature and the resulting clinker ground so fine that at least 90 per cent of it will pass through a sieve having 10,000 meshes to the square inch. An immense outlay of money for plant and machinery is necessary for the manufacture of cement. The machinery must be very heavy and solidly constructed, as the work of crushing the rock is hard and the wear and tear on the machinery is great. This requires machinery of the highest grade, and also

the cement dust which is aways present is hard on bearings, motors and other rubbing surfaces. Highly skilled and correspondingly high-priced labor is required to insure quality.

Production of iron and steel, like coal, is comparatively limited in quantity, and when used alone they cannot accomplish that which is done best with concrete. The source of supply from which concrete is made is unlimited. The quantity of cement is almost beyond comprehension. In the Woolworth Building in New York it is claimed that 70,000 barrels of cement was used in the general construction. The amount of cement used in building the Panama Canal was reported as 3,000,000 barrels.

Cement, however, is only one of the necessary ingredients of concrete, and while much of its strength depends on the cement, the sand and stone or aggregate play an important part in the construction of concrete. The use and procedure in the application of these important adjuncts to a successful concrete structure in which steel beams are imbedded to give additional strength are well understood by the engineer skilled in the use of concrete; but at the same time, the subject is so complex that it cannot be treated here in this short article. A reference, however, to the functions promoting success in its application is almost imperative. In the application of concrete, the cement must be sufficient in quantity to attain the ends desired; the aggregate should be correctly proportioned; the sand should be clean and sharp and the stone hard and not over 2 in. in diameter; an adequate quantity of water must be used, but not enough to drown out the cement; the concrete should be solidly tamped in place to eliminate the voids; the material should be thoroughly mixed; where the new work is to be bonded to old work, all grease and dirt should be removed and the surface clean and wet; the concrete should not be applied to heated surface or exposed to the direct sunlight, as it is dried out before it has time to set; it should not be allowed to freeze while setting and if machinery is to be placed on it, as an engine foundation, it should be given sufficient time to become thoroughly hard before the weight is applied to prevent settling and possibly throwing the machine out of line. Expansion joints should be provided where the concrete is subjected to an extreme change of temperature, as in a street pavement; the concrete should only be mixed in such batches as will be used immediately to prevent its becoming set before it is used, and if it is wet occasionally while setting, especially when in a warm place, it will set more quickly and harder than otherwise.

The war in Europe is not without its uses for concrete. It has been found very necessary in making foundations and emplacements for the heavy artillery in use there. As it is necessary to get these foundations into use at the earliest possible moment, a quick-setting cement has been discovered and is being used for this purpose. This consists of a mixture of magnesite and magnesium chloride, made into a cement and mixed with sand and stone in the usual manner. This makes a quick-setting concrete which becomes as hard in 12 hr., as ordinary Portland cement concrete will in 3 or 4 days.

RUN-OF-MINE coal weathers better than finer grades and is therefore better for storing.

Lubrication of Ammonia Compressors

BY THOS. G. THURSTON

THE average ammonia compressor generally gets an overdose of oil. Operators will cut down the oil consumption on their steam engines or air compressors to the vanishing point; but when it comes to the ammonia compressor, they souse it with oil.

An ammonia compressor works under totally different conditions from those of an engine or air compressor. In an engine, new steam is admitted to the engine at every stroke; this carries the oil away with it, consequently it must be replenished.

In an air compressor, the same thing takes place, the fresh air taken in at every stroke carries the oil away with it.

With an ammonia compressor it is different; after the system has been run for awhile, there is always a small amount of oil circulating around the system; ammonia itself is also slightly lubricating, consequently the compressor requires practically no oil. What little may be required will be supplied by what leaks in around the rod and what is carried into the suction through the gas relief line from the oil lantern in the stuffing box. The only exception to this is a vertical double-acting machine. This may require a small amount in the top of the cylinder, as the oil that is carried around in the system, as well as what is carried in with the rod, all goes to the bottom, and the top valves and top of the cylinder will run pretty dry. A half pint per day is sufficient for this purpose.

The average ammonia compressor is provided with an oil lantern in the center of the stuffing-box and a number of the horizontal double-acting machines have an additional oil gland in front of the stuffing-box; in many cases, this is provided with an oil dump that circulates a continuous stream of oil on the rod. In this case, very little oil is needed for the oil lantern in the center of the stuffing-box.

If the oil gland in front has only an oil cup, the oil lantern in the center will need a little more oil, as the lubrication at the front oil gland will not be so copious. A pint to a quart per 24 hr., depending on the size of the machine, should be sufficient.

Packing should always be renewed before it gets old and hard because the packing in this condition creates a greater friction and this requires more oil and it also wears the rod more, no matter how well it is lubricated.

Great care must be taken in the selection of the right kind of oil. The ideal oil for an ammonia compressor should keep the same consistency at all temperatures. It should not congeal at the lowest temperatures to be met with in the operation of the system and it must not vaporize at the highest. The best ice machine oils are a compromise between these 2 extremes. On low temperature systems, the temperature will vary from about 20 deg. below zero to sometimes 300 deg. above. If the oil does not have a low congealing point, it will congeal in the expansion coils at this low temperature and adhere to the walls of the coils much the same as when lard congeals in any vessel when it cools. This forms an

excellent insulation where it is not wanted. On the other hand, if the oil has a low flash point, it will vaporize at high temperature, forming a foul gas in the condenser and it also reduces the capacity of the compressor by the increased re-expansion in the cylinder on the beginning of the suction stroke.

To test the oil, draw off a small amount of ammonia into a cup or small can and into this set a small glass or anything else convenient, with a sample of the oil to be tested in it. The temperature of the boiling ammonia will be about 28 deg. below zero and that of the oil will be nearly the same. If the oil will stand this temperature and still remain fluid, it is very good as far as low temperature is concerned.

Now put a small sample of the oil in a can or other vessel, place a thermometer in it and raise the temperature slowly to about 300 deg. If the oil does not vaporize at this temperature, there will be no trouble from this source in the system.

To keep the system as free from oil as possible, the oil trap in the discharge line must be blown out regularly. The frequency with which it should be blown out depends on the size of the trap and the amount of oil used. A small trap on a system where a large amount of oil is used, should be blown out oftener than a large trap on a system where little oil is used. In the first case, once a day would not be any too often, while in the second once a week, or in some cases even once a month, will be sufficient.

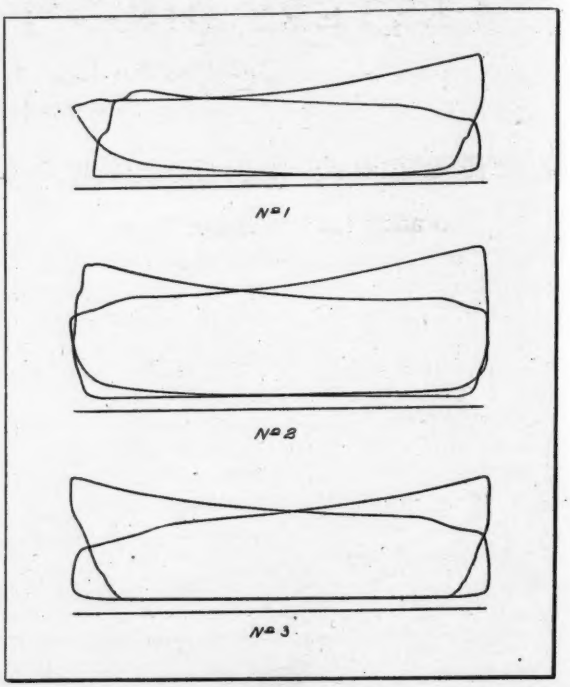
The less oil there is in the trap, the less danger there is of any being carried through into the system; at the same time, a little ammonia generally blows out with the oil every time the oil is blown out and this wastes ammonia. Consequently, judgment must be used about how often the trap should be blown out.

The temperature at which a machine is run, has considerable to do with the amount of oil used. If the machine is run cold, little or no oil is needed. If the discharge is very hot, more oil must be used. To determine the proper amount, take out the discharge valves and inspect the cylinder once in a while. If the valves work freely and there is no sign of wear and the cylinder is smooth with no signs of scoring or cutting, the oil supply is sufficient. If there is an excess of oil present, cut down on the amount used.

Cards from Ice Machine

THE CARDS shown in the accompanying figure were taken from a well-known make of ice machine just as it was turned over by the erecting men. The machine was a tandem affair with the ammonia piston on the same rod as the steam and was 10 by 7 by 14 in. and double-acting. It had a throttling governor and made 90 r.p.m. with 80 lb. steam pressure, a 40 spring being used. The valve was of the indirect piston type with direct connection to eccentric. No. 1 card shows the steam distribution previous to making any changes. After lengthening out the valve stem about ½ in., No. 2 diagram was the result. Events were too late, notably compression and release, and the eccentric was moved ahead about ¾ in. on the shaft and No. 3 card was taken.

I would like to have some reader criticize No. 3 card, particularly about the compression as both pistons are on the same rod and reach the end of their strokes together, and it would seem that less than the usual amount might do owing to the compression in the ammonia cylinder.



CARDS TAKEN FROM A RECENTLY ERECTED ICE MACHINE

J. A. MCINNIS.

Bottled Ice

BOTTLED ICE, generally speaking, is ice that freezes faster at the top than at the bottom, and when the block finally closes up there is a small quantity of water entrapped at or near the bottom.

This is brought about, of course, by the brine in the tank getting colder at the top than at the bottom, a condition indicating a lack of brine circulation. Even with a good brine circulation, this trouble is liable to occur to some extent, when the brine in the tank is used in cooling cold storage rooms as well as for freezing the ice.

I knew of such a condition, where 2 30-ton ice tanks, connected in series with a brine cooler, were used in refrigerating a large cold storage house. The ice would bottle at certain times during the year, generally in the spring and fall. The brine was pumped from the tanks through the brine cooler, then to the cold storage house, from the house it returned to headers in the bottom of the tanks, from these headers there were 1¼-in. perforated pipe which extended lengthwise of the tanks and under each row of cans. As long as the return brine from the house was colder than the tank brine, there was no trouble; but on account of loading the house in the spring and fall, this brine would return warmer, thus causing the ice to bottle.

To remedy the trouble, a larger brine cooler was installed and the house brine was circulated independent of the ice tanks.

GAY A. ROBERTSON.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable. We Make The Drawings

Locating Leak in Boiler Seam

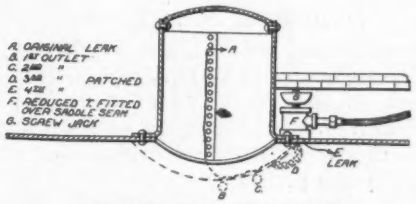
FOLLOWING is a description of a steam leak in a boiler dome which occurred Nov. 27, 1915, at a plant near Trenton, N. J. For the previous 4 months, continual trouble was experienced with the saddle joint of the steam dome on No. 2 boiler, of a battery of 3 horizontal tubular boilers.

The boilers are 66 in. in diameter and 16 ft. long, were built in Trenton in 1902 for a pressure of 125 lb., the longitudinal seams were triple riveted butt joints, with double straps, thickness of material 7/16 in. Pitch of rivets 3½ in. and 7 in.

No evidence of weakness developed until July, 1915, when a leak was discovered on the saddle joint of the steam dome on No. 2 boiler nearly in line with the longitudinal seam of the dome, a slight grooving had occurred, which was remedied by installing a mushroom head rivet and calking the edge of flange. Some weeks later, another leak developing about 12 in. from the first one, was also drilled and a mushroom head rivet installed and edge of flange calked.

In October, another leak was found which had grooved the sheet in 2 places about 5/16 in. deep on either side of the rivet. A patch was fitted over the defect and several of the rivets were calked. About Nov. 10 another leak developed still further around the flange of dome and almost on the crown of the boiler sheet; this also leaked on the sides of a rivet and when discovered had cut 2 grooves in the sheet also about 5/16 in. deep. By this time the owners of the boilers were becoming anxious, and considered that this leak disease had become chronic. All repairs on these boilers had been made by the original makers, but owing to labor trouble their shop was closed, and a machinist doing other work in the mill heard of the trouble they had experienced. No. 2 boiler had been down for several days and as the plant used all the power developed it was handicapped by the loss of this boiler. The machinist, H. Stahl, stated that he would stop the leak for them or give his time and trouble for nothing, and the offer was accepted. After 2 unsuccessful attempts he was struck with the idea of reversing the usual order of things by making the boiler leak on the inside and then finding the original source of trouble.

To effect this he cut away part of a 3-in. tee to a fairly good fit over the flanging of saddle seam and boiler shell, the upper opening of the tee was plugged and a ¾-in. nipple fitted to the reduced end as shown. A steam hose was fitted to the nipple, a special screw jack made to accommodate the height between the tee and the brickwork, and a thin lead gasket was placed under the tee, the screw jack forcing the fitting onto the boiler shell and saddle flange leaving the 2 grooves in the boiler shell inside of the gasket, the steam hose was then connected to the adjoining boiler and when steam was turned on a jet of steam shot across the dome from a point 28 in. above the boiler shell in the calking edge of the dome longitudinal seam. This seam was calked and the boiler refilled and a hydrostatic pressure of 125 lb. was applied with no sign of a leak, although nothing had been done to the saddle joint; later, the grooves in the boiler shell were welded over, making a perfect job.



METHOD OF LOCATING LEAK

One interesting feature of this job is the distance the leak traveled, showing that leaks in seams may not originate anywhere near the point of outlet, also the fact that repairing the outside of a leaky seam is only a subterfuge and the next weakest point in the seam will give way, if the original source of the leak is not discovered and remedied. Materials for such a test are always at hand and the ingenuity of applying them as in this instance deserves to be recognized. R. W. ROBINSON.

A Little Pump Trouble

SOMETIME AGO I read in Practical Engineer of an engineer having trouble with feed pumps running at slow speeds, the slide valve staying between ports and causing the pump to stop by reason of the exhaust port or pipe being too small or clogged.

A few days ago I was called to fix a pump of the boiler feed type run by compressed air, which stopped from no apparent cause, as the man said, and he had the idea that the gasket of the slide valve had blown out; he could tell by the exhaust blowing steady. He spoke naturally, without a smile, so I presume he had never seen the inside of a pump; he was running the pump because he was a relative of the boss and knew too much to read a good mechanical paper.

Coming down to facts, I opened both drain valves to see if there was air going through the piston; but there was not, and then I thought of the valve trouble referred to above. The exhaust pipe being only 4 ft. long, I disconnected it and saw that the pipe was clogged with ice, all but a ⅛-in. opening. I informed the man that a

new hole had to be bored in the pipe and he looked at me surprised. I went to the forge and in a minute had the ice melted, then I put the pipe back and the pump ran as if nothing had happened.

This was very simple indeed, but it is easy to forget a thing one never learned. CHAS. LABBE.

Installing a Gasket

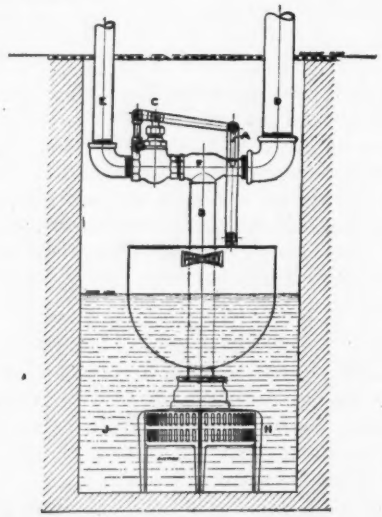
I WAS much interested in A. D. Palmer's method of "Installing a Gasket," in the Feb. 1 issue, page 183; but instead of cutting my gaskets the size of the flange, and cutting out bolt holes, I cut them so they will fit inside the bolt circle.

In this manner, it requires less than half the packing, and my experience has been that better service is the result. In putting in the gasket, it is only necessary to remove the bolts from one side of the flange, preferably the upper half, then the gasket may be dropped into place and the remaining bolts will center and hold the gasket in place while the bolts are being tightened up.

J. M. ROW.

Automatic Sump Ejector

WE NOTICED on page 137 of the Jan. 15 issue of Practical Engineer an article by H. K. Scholefeld describing an automatic lever and float mechanism he has built and attached to the wall for the purpose of turning on and off a steam ejector used for draining seepage water from boiler feed pump pit.



SELF-CONTAINED SUMP EJECTOR

While this device is quite ingenious, it is rather complicated and we thought perhaps readers might be interested in knowing of a self-contained apparatus designed for this purpose and already on the market, being manufactured by the Penberthy Injector Co.

The cut shows this device, which is regularly built to operate on water pressure, but which the builders furnish special to be operated by steam. The operation, referring to the cut, is as follows: The device is installed in a sump to which the seepage water drains and connected to steam or water service line and discharge line to sewer by pipes E and D. When water rises in the sump, the float travels up until the bottom of the slot in connecting rod A pushes upward on the lever of quick opening valve C. This upward pressure opens the valve and admits the operating steam or water through the ejector F and as the water is drawn from sump through suction pipe B, the float travels down until its weight acting upon the end of valve lever closes the valve instantly, shutting off the operating power until another rise of water level in sump turns it on again.

The strainer is a combination strainer and foot valve which prevents absolutely any possibility of the pit being flooded by a backflow from the sewer. L. A. PURSELL

Burning Anthracite Coal in Underfeed Stokers

A SHORT TIME ago we tried the experiment of burning anthracite furnace coal in the underfeed stokers. The coal usually used is crushed mine run bituminous, but there was about 2 tons of anthracite egg left from an old plant in a distant building which had been connected to the the power plant. This coal had been in storage several years, and was not very lively. The load on the boilers was light and the coal consumption was about 2½ tons per 8-hr. watch in 2 boilers.

Instructions were given to the fireman to mix about 1000 lb. of anthracite with the coal used on his watch. Instead of mixing it in the bunker or in the car before firing, he brought in 2 hoppers full and fired it all at one time, then fired the regular coal on top. The stokers handled the coal all right; but instead of piling up in the furnace as the fine coal does, it simply rolled down the trough onto the dump plate without burning. This pushed the fire down so low that it had to be pulled back with the hoe, and in one boiler wood had to be used to start the fire again. The balance of the coal was fired by putting about 500 lb. in each car of 1 ton when filling the car in the bunker. This coal could not be mixed in the conveyor, as it would not go through the screen. When mixed in this manner, the coal worked all right and no trouble was experienced in keeping plenty of fire.

Pea coal or smaller can be burned without difficulty in this type of furnace provided there is plenty of draft. In our case, the ratio of speed of the fan engine and stoker has been experimented upon and made such that the clutch on the stoker shaft is seldom used. With the fine grades of anthracite coal, this same speed ratio would not be correct, and would probably have to be changed or the clutch used. Several years ago, the writer was operating 2 boilers using Goshen (Ind.) coal. This coal is high in volatile matter, the analysis being about as follows: Moisture, 13.79; volatile, 35.45; fixed carbon, 35.67; ash, 12.09; sulphur, 3.00. This coal works well in the underfeed stokers without making objectionable smoke; but when 1 or 2 shovelfuls are thrown in on top of the fire, it smokes excessively.

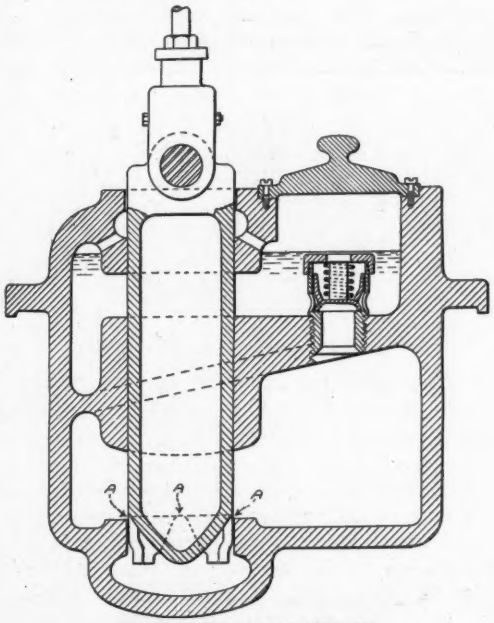
We had an offer from a local dealer of 8 or 10 tons of yard screenings from domestic anthracite coal which ranged in size from pea coal down to dust. This was purchased at a reasonable figure and mixed with the Goshen coal in the proportions of about 1 to 3 and fired in the usual manner. The result was that we had very little clinker trouble, could force the boilers to almost any extent without dropping the pressure and operated without making smoke.

No tests were made, but from the daily kilowatt-hour output generated and the coal used the consumption per kilowatt-hour was considerably reduced. This was partly due to using a coal with higher average B.t.u. per pound, but to a greater extent to the fact that the boilers were set low down and the long flame soft coal was not completely burned, although it made little smoke except when the boilers were forced beyond the rated capacity. Adding the anthracite coal, however, produced a shorter flame, lowered the amount of soft coal used per square foot of grate surface per hour and consequently reduced the quantity of volatile gases to be consumed.

J. C. HAWKINS.

Efficient Dashpot

THE ACCOMPANYING sketch shows a dashpot that is used on a Corliss triple expansion engine which is direct-connected to a Riedler pump. The pot has 2 chambers, a lower and an upper. The plunger and a partition with a check valve inserted separates the lower from the upper chamber. The lower chamber is filled with engine oil and the upper almost.



CROSS-SECTION OF DASHPOT

The plate above the check valve is to replenish the oil and examine or repair the check valve if required.

The sketch shows the plunger down. When it is raised, a vacuum is formed in the lower chamber and when released, it drops and forces any air or oil that has leaked down around the plunger into the lower chamber, out through the check valve.

To keep the plunger from striking the bottom or seating too hard, oil is strapped into the space below it. There are 4 avenues for the oil to escape, as shown at A. As it comes nearer to rest the avenues get smaller until seated. Its action is quick and it seats rather hard, but does not make much noise. It has no regulator and works as well at a speed of 40 as at 75 r.p.m., which is the range of speed at which the engine operates.

L. K.

Burning Lignite

IN REGARD to Mr. Gruneberg's article on the burning of lignite, I have used the McClave system for several years, burning that grade of coal (lignite) and the instruction when making the installation was to leave 18 in. between bridge wall top and shell of boilers. Possibly it was a mistake, but the article in Practical Engineer called for 18 in. between grates and shell of boiler.

I have burned lignite for several years with the old style settings, and had more or less trouble in holding steam under old conditions. With the McClave system, I have increased boiler capacity as much as 40 per cent, and have run as high as 100 per cent on peak loads. Another thing, with the McClave system the boiler pressure will not vary over 5 lb. burning lignite, as there is automatic control of the air to the blowers. The automatic regulator is actuated by the rise and fall of steam pressure, and works on 2 lb. variation; I have seen times when the regulator would cut off the supply of steam to the blowers, as many as 3 times without firing up. I find from the experience that I have had with the McClave system in burning lignite it is best to carry a fire from 2.5 to 3 in. thick.

I have visited a number of plants that had special equipments for burning lignite, and have found none where you can remove your ash from furnaces without the loss of steam and without any unburned fuel going into ash pit. In the McClave grates the forward movement keeps the clinkers broken up and the fine ashes sifted into the pit; and in this movement the opening is not larger than the mesh of the grates, those I have being ¼-in. mesh.

If any engineers having trouble in holding steam in burning lignite will state the trouble, I will give them all the data that I have secured in 10 yr. experience in burning this coal.

D. G. COUNTS.

Belt Joints Should Not Weaken

MANY BELT MEN seem to believe that if oily substances are allowed to penetrate leather belts the cemented joints will suffer.

It is a fact that joints of this kind often open up, cause belts to break, and cause shut-downs for repairs; but it is not due to lubricant alone, as I will explain.

I have investigated this point with considerable care and have learned that excessive lubricant or treatment will not cause a belt joint to open up unless the belt has been mistreated at the start. If the belt is allowed to become wet, for instance, after which it is allowed to become dry, it will naturally harden and stiffen. Then, in passing around the pulleys, the hardened leather in the neighborhood of the joint creates a sort of grinding action on the cement. The cement is broken and partially pulverized. Space is thus formed in the joint seams into which the lubricant will penetrate if too much is used, and we then have the danger of the joint opening up and pulling apart.

If the belt is lubricated from the time it is installed and maintained in a properly pliable condition, however, there will be no danger of the cement breaking into bits and the joint will not pull apart.

N. G. NEAR.

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Repairing a Valve While in Use

THE THROTTLE valve spindle on a 300-hp. Corliss engine wore out the square thread in the bonnet yoke, Fig. 1A, the spindle being also damaged, but not beyond the possibility of future use. The engine had been started for the day's run before the damage was discovered. The only possible way to stop the engine was then to shut off the steam at the boiler. The construction of this valve was such as to make it possible to remove the spindle while the engine was running by removing nut B from the valve stem.

We removed the spindle, leaving the engine at work. From a cast-iron fire bar bearer of 2 by 4-in. section,

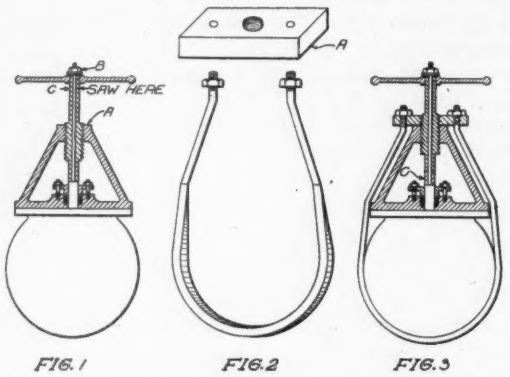


FIG. 1. LOCATION OF WORN THREAD IN VALVE YOKE
FIG. 2. PARTS FOR MAKING REPAIR
FIG. 3. VALVE AFTER REPAIR WAS MADE

taken from the scrap pile, we made nut A, Fig. 2. In this was cut a square thread, fitting the worn spindle, and holes were drilled for a clamp as shown, which was forged while the nut was being cut. The job, when finished, is shown in Fig. 3. The handwheel was keyed to the spindle 2 in. farther down, and the portion sawed off at C, Fig. 1, was inserted at C, Fig. 3, thus making up the proper length while bringing the threaded portion of the spindle 2 in. higher outside of the yoke.

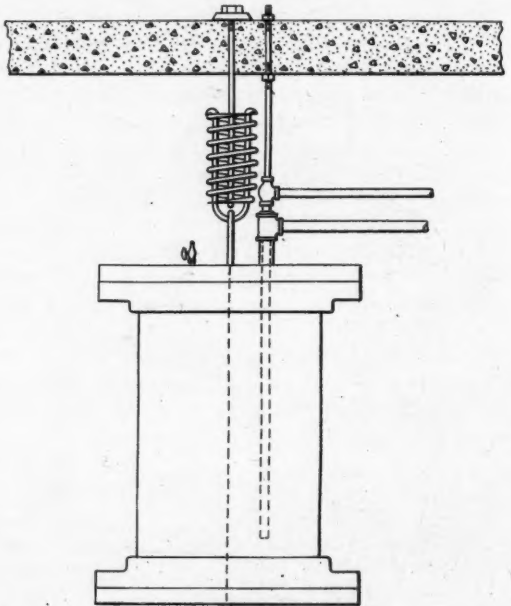
The application of the new nut and clamp can be seen. The engine was then again under control of the throttle.

H. K. SCHOLEFELD.

A Homemade Steam Trap

IN THE accompanying illustration is shown a continuous flow trap, similar to one I have used in our plant, on low-pressure heating return mains. It has proved satisfactory for this service and is so simple in construction that one could be built by any engineer.

The body is a 12, 14 or 16-in. nipple, having flanges on each end and a blind flange bolted to each flange, the bottom blind flange being drilled and tapped for a blowoff pipe. The top flange has a hole drilled and tapped in the center for a ¾-in. eye bolt. In our installation, the trap, etc., is suspended from a reinforced concrete floor in the manner shown, hanging on a compression spring, the size of which depends upon the construction and weight of the trap. A second hole is drilled in the top flange, to admit a pipe having a large enough diameter to allow a smaller one to pass down through it, almost to the bottom of the trap. A long thread is cut on this pipe, and it is screwed through a bushing or reduced tee from the inside, bushing or



A HOMEMADE STEAM TRAP FOR USE ON LOW-PRESSURE HEATING RETURN MAIN

tee having been re-tapped from the inside, the thread having been long enough to allow screwing an ordinary angle valve on it. The threads are filed off the valve stem and it is provided with an extension long enough to reach through the floor of trap support, whatever it happens to be. A long thread is cut on this stem and provided with 2 nuts to lock the valve in any desired position.

A hole is provided in the top flange for a suitable air cock. The pipe connections to the trap should be long enough, at least 5 or 6 ft., to allow it to swing reasonably free.

Water enters the trap through the tee at the top and is discharged through the pipe extending to the bottom, the rate of discharge being controlled by the weight of the water in the trap, changing the position of trap with reference to the valve.

The trap could be provided with a gage glass, which would prove an advantage in regulating its operation.

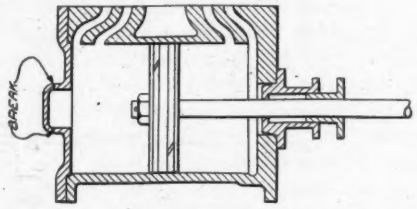
BURT R. BAY.

Quick Pump Repair Job

READING IN Practical Engineer about novel and quick pump repair jobs reminded me of a pump breakdown that I experienced in my earlier days of engineering.

I had the honor of being chief engineer, oiler, fireman, ash wheeler and general master mechanic of a "one-horse 2 by 4 plant," consisting among other conglomerations of junk, of a 40-hp. boiler, engine and one feed pump.

There was no engineer employed at night, so part of the night watchman's duty was to keep water in the boiler and the fires banked during the night and steam up in the morning; when I came about 7 a. m., everything was in readiness to start. On the morning that I have in mind, I must have been extra ambitious or I received a mental telepathy message that something was wrong; anyway I came down on the job about 10 min. after 6 instead of a quarter to 7 as usual.



CYLINDER HEAD SHOWING BREAK

As I stepped into the boiler room, the night watchman met me in a hurry; he was white in the face and thoroughly scared about something. Taking me forcibly by the arm, he led me over to the feed pump and pointed to the steam cylinder head. The head looked all right at first glance, but on examining it a little closer, I saw a round opening or hole in the head about 2½ in. in diameter which had been knocked out (by a slug of water in the cylinder) as slick as if it had been drilled or bored out.

The sketch illustrates the type of head and the location of the break.

At first I hardly knew what to do or how to proceed, but I was determined to have the plant running at 7 a. m.

I first thought of making a wooden head; but the nut on the piston protruded beyond the end of the cylinder when the piston was at the head end of its stroke, so it would take too long to make a wooden head with a recess in it to accommodate the piston rod nut.

The next idea that came to my mind was to tap the hole, which was just about the right size to tap out for a 2½-in. pipe thread, and plug it with a 2½-in. pipe plug. But on investigating I found I had neither a 2½-in. tap nor pipe plug. As I could not put threads on the inside of the projection, how about the outside? I thought. On measuring the outside diameter of the projection, I found that it was just right to thread with a 4-in. pipe die for a 4-in. pipe cap; this was just the thing. I had no 4-in. cap, much less a 4-in. die, but I knew there was a pipe die of that diameter and 4-in. pipe caps also, about ¼ mi. away where the gas company was laying a 4-in. gas main.

I did not lose any time going over there and, as luck would have it, the foreman of the pipe gang had just showed up on the job. I told him my tale of woe and got the pipe die and the 4-in. cap by turning over my "Ingersoll" as security and good faith that I would return the die and another pipe cap.

In my hurry I forgot to get the stocks for the die and, of course, did not discover that until I was back in the engine room. I did not have a monkey or pipe wrench large enough to turn the die, so I clamped the die horizontally in the vise on the bench and placed the cylinder head with the projection down, into the die and turning the head by means of a long piece of pipe and 2 bolts in the bolt holes of the cylinder head we succeeded in cutting a fairly good thread on the projection. We screwed up the cap on the projection the same way as we cut the thread by placing the cap in the vise instead of the die.

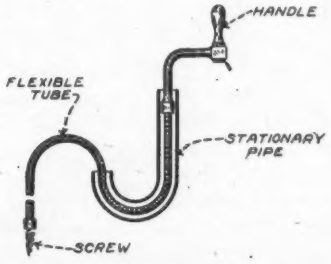
I glanced at the clock and it was 10 min. to 7. I hastily bolted up the head on the pump and was running all o. k. at 7 a. m.

C. E. ANDERSON.

Cleaning Drain Pipes

IN THE Dec. 1 issue, Mr. Benefiel describes the arrangement which he uses to unstop drain pipes, sinks, closets, etc.

We are using a tool for this purpose, and especially for closets, which is giving excellent results and which has met a want in our plant. It is called "The plumber's friend" and consists of a handle to which is attached



METHOD OF CLEANING DRAIN PIPES

a long coil spring about ½ in. in diameter. This spring consists of 2 or more coils about 4 to 6 ft. long, part of which are wound right handed and part left handed, with a sharp screw at the lower end. The upper part works in a stationary pipe which prevents it from kinking when being turned. This shaft will readily pass through a closet trap, and when being turned will catch any obstruction that may have become lodged in the soil pipe or trap and which can be readily removed or broken up so that it will pass through.

We have 2 or 3 which, while not constructed exactly alike, employ the same principle of operation; that is, a screw on the end of a flexible rod. We use these in addition to the usual force cups, and find them of valuable assistance to the plumbers. These tools can be purchased of plumbing supply houses at a low cost.

J. C. HAWKINS.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Oakland Cal., Examination Questions and Answers

BELOW ARE a set of questions, together with answers, recently asked in an examination for the position of chief engineer for the City of Oakland, Cal.

This set constitutes the second half of the examination and supplements those published on page 1059 of the Nov. 15, 1915 issue.

1. What is the difference between absolute and gage pressure?

2. If the safety valve fails to blow off when the proper pressure is reached, how may the situation be remedied?

3. What are the causes of knocking in an engine bearing and what remedies should be used to stop it?

4. What is the pressure in pounds per square inch at the bottom of a 12-in. pipe, 135 ft. high, and filled with water at a temperature of 60 deg. F.?

5. How much power is required to pump 12,000,000 gal. of water 125 ft. high in 12 hr.?

6. Explain the action of an automatic control on a sump pump.

7. What is a steam trap?

8. If a steam trap should get out of order, how can it be repaired without shutting down the system?

9. How is steam measured for heating purposes?

10. What causes water hammer in a steam pipe, and how may it be stopped?

11. What is the most efficient pressure for steam-heating purposes?

12. Describe one form of pressure reducing valve.

13. How would you figure the required size of radiator for a given room?

ANSWERS

THE PRESSURE on any horizontal area of the earth's surface is due to the weight of all the air vertically above that area and at sea level is ordinarily assumed to be about 14.7 lb. per sq. in.

The pressure exerted by a fluid in a closed vessel such as that of steam in a boiler is ordinarily measured by a pressure gage. The reading of such a gage indicates the pressure exerted by the contained fluid above the pressure due to the weight of the atmosphere, and it is therefore referred to as "gage pressure."

Adding the value of the atmospheric pressure to that indicated by the gage will give the absolute pressure.

2. If the gage is correct and the operator knows the proper pressure at which the safety valve should release, has been reached, the trouble would in such a case as this be due to sticking of the valve or tampering by some unauthorized person. Generally the mere raising of the lever by hand or a few taps of a hammer, if it be of the pop type, will free it if stuck and cause it to work properly; if this treatment must be resorted to frequently, the valve should be taken down and overhauled.

Should, however, the failure be due to tampering, the only thing to do is to reset it properly at the earliest opportunity.

3. The principal cause of pounding in engine bearings is lack of adjustment to compensate for wear. No matter how profuse lubrication may be, wear naturally occurs and adjustment must be made from time to time. On the other hand, one should not be continually tinkering with the engine bearings, as some engineers are prone to do, for dire results will surely follow.

If an engine is properly erected, the shaft will be square with the center line of the engine, and if the bearings are properly adjusted, the engine should operate quietly.

As the main bearing wears, adjustment is made from time to time, which naturally crowds the shaft towards the cylinder, but as the outboard bearing cannot be adjusted to compensate for the wear in the main bearing, the shaft will soon get out of square. With an engine of this design, the shaft should be squared up and shims added behind the rear quarter box so as to hold the shaft in the same position as it was when erected.

Should the engine be belted forward, the wear on the outboard bearing will be in the same direction, continually, while the rear quarter box of the main bearing will have its usual wear, owing to the intermittent thrust of the piston. This arrangement soon throws the engine out considerably with consequent pounding.

When the shaft is out of square, the crankpin and crosshead-pin boxes will slap from side to side, causing noise, and a continuance of this operation will cause the brasses to wear in the rod ends and even after the shaft has been squared up, these boxes will continue to pound unless shimmed up. Shimming strips may be sweated onto these boxes, or if the wear is so small that very thin shims must be used, plane off 1/8 or 1/16 in. less the wear and sweat on a piece of brass this thickness and scrape the brass to a perfect fit.

Of late years, engine builders have given more attention to engine adjustment and the main and outboard bearings are usually provided with adjustment both ways from the squared center line of the shaft. Sometimes either the main or outboard bearing, or both, is provided with a bottom wedge adjustment in order to keep the shaft level.

A cause for pounding little understood and, in fact, ignored by many engineers, is loose babbit. How frequently we see bearing shells which have been melted out for rebabbiting, where the anchor holes are but an ordinary hole drilled in depth not more than the diameter of the hole.

Such a method cannot be criticized too severely. If for any reason anchor holes or slots are not cast in the shell, and it is necessary to drill them, the holes should be generous in diameter and depth, if the stock will stand it. Let us suppose an instance where the shaft is, say, 12 in. in diameter, and that the slot cores "fell out" when casting, leaving the shell wholly or partially devoid of any method of holding the babbit. Anchor holes should be at least ¾ in. in diameter and fully as deep, and at the bottom, holes about ⅜ in. should be drilled at an angle so as to form a "root" to the babbit.

These large holes should be spaced not more than 2 in. apart (less would be better), and should be slightly countersunk at the top so as not to leave a sharp edge, in which case the anchor may easily break off in operation.

Another cause, or, rather, presumed cause, of pounding in engine bearings, is a noise having its origin in another place, but which seems to be in the crankpin or main bearing. It occasionally happens that a crosshead shoe will become loose, especially if it be of the nonadjustable kind. By this is meant that type of shoe which is bolted directly to the crosshead itself, shims being inserted from time to time as required. To do this, it is necessary to remove the connecting rod and rotate the crosshead until the shoe comes out at the side of the bore, where it can be removed and shims inserted.

If the retaining screws become loose in operation, the shoe is not gripped tightly and the continued reversal of motion soon causes a little lost motion, which grows rapidly. If allowed to become too bad, machine off where wear has occurred and rivet on a steel shim, afterwards fitting the parts snugly and renewing the bolts attaching shoe to crosshead, using a size necessary to make a good job of it.

Lateral motion of the shaft is one cause of an annoying pound in the main bearings of engines. It is necessary to have at least some play here, but occasionally it is too much. Sometimes a wobbling wheel will cause lateral motion, or a wide band wheel which, though it may balance perfectly, could it be tested on gigantic balancing rolls, might be heavier on one side of the rim than the other, this defect in the 2 halves of the wheel being on opposite sides of the rim.

If the engine is direct connected to a generator, it is possible to have the stator so perfectly set that the rotor moves in practically a neutral path and no magnetic influence is present to hold the shaft steady either against the crank or the collar. The remedy in a case like this is to move the stator laterally, preferably away from the main bearing, a small amount, in which case the magnetic influence will hold the crank constantly against the bearing.

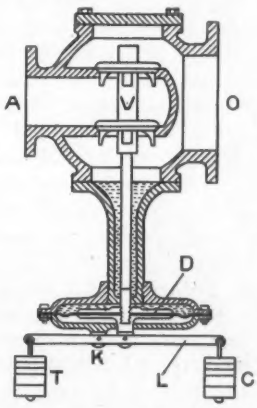
If the shaft be moved too far, the thrust of the crank against the bearing will be so great as to cause heating.

4. Water at a temperature of 60 deg. F. exerts a pressure of 0.433 lb. per sq. in. for every 1 ft. of head. The pressure at the bottom of a 135-ft. head will, therefore, be equal to the product of 135 times 0.433, or 58.45 lb.

5. Twelve million gallons per 24 hr. is equivalent to 500,000 gal. per hr. One gallon of water at a temperature of 62 deg. F. weighs 8.3356 lb., so that 500,000 gal. represents a weight of 8.3356 times 500,000, or 4,167,800 lb. This raised to a height of 125 ft. will call for an expenditure of 125 times 4,167,800, or 520,975,000 ft. lb. of work per hour, which is equivalent to 263.12 hp. per hr.

6. Sump pumps may be electrically or steam operated according to local conditions. In the case of the former, an ordinary float switch controlling the motor-supply circuit is used to start and stop the pump motor at pre-determined levels; if the pump is steam-driven, this float operates a valve controlling the steam supply.

The float, whether controlling an electric switch or the steam supply, may be so adjusted that as long as, let us say, 1 ft. or less of water be in the sump, the supply of electric current or steam is cut off. Should, however, the water rise above this 1 ft. level, the rising of the float will close the electric circuit or open the steam supply line, whichever case it may be, and start the pump. When the level of the water in the sump recedes, reaching the 1 ft. level, the pump will again, due to the position of the float, be automatically stopped.



TYPICAL PRESSURE REDUCING VALVE

7. Traps are devices used on steam lines or systems for the purpose of removing condensation which may collect and do damage to the piping or apparatus used in connection therewith. This is done, or should be done, when the trap is in working condition without the loss of steam.

Steam traps may be divided into 2 classes, depending on their use,—return and nonreturn. The former receive the condensed steam and return it to a boiler having considerably higher pressure than that acting on the returns. Nonreturn traps are used where the water of condensation is not returned to the boiler but is discharged into a sewer, hot well, etc.

8. It should not be necessary to shut down the system in order to repair a steam trap.

In the line joining the system and trap should be placed some form of shutoff valve allowing the trap to be isolated from the system.

When a trap is in need of repairs, this valve may be closed and the trap taken apart; but to insure reasonable drainage of the system, the condensation which may collect should be removed at frequent intervals by opening this shutoff valve until dry steam appears. This will do until the trap can again be placed in operation.

9. We presume this question refers to the measurement of steam used in installations supplied from an

outside source as, for example, in central-station heating systems. In such cases, the condensation returned from the radiators is caused to pass through a meter, usually made up of a series of buckets of given volume, mounted upon the periphery of a small wheel or disc. Condensation from the system is directed into one of these buckets, which, as it fills, is caused to move a certain fixed distance and the water dumped, when the following bucket is filled, moved and dumped, and so on. The shaft of the wheel or disk upon which these buckets are mounted is fitted with a gear meshing with a train of gears which operate the hands on a series of dials which indicate the number of pounds or cubic feet of condensation passed through—or, in other words, the quantity of steam used.

10. Water hammer, as its name implies, is caused by water contained in a steam line. This action is quite noticeable in the case of steam heating systems, in which steam is turned on after having been cold for some time. The steam coming in contact with the comparatively cold water in the pipes is condensed, forming a vacuum and causing the water to collect at some given part of the system. It is this sudden rush of water striking the pipe or fittings which results in the hammering.

Water hammer may be prevented by running all lines so that the system will be drained of all water, and providing traps to care for this.

11. Nothing definite can be said relative to the most efficient pressure to be carried on steam heating systems. The pressure required varies with the type of system, length of heating mains, outside temperature and temperature to be maintained.

12. A typical reducing valve found on the market is shown in the accompanying illustration. The low-pressure steam acts upon the top of flexible diaphragm D, and the weighted lever L, which may be adjusted to give the desired reduction in pressure, acts upon the other side.

The movement of the diaphragm causes the balanced valve V at the upper end of the spindle to open or close, as may be required to maintain the desired lower pressure. Weights T and C prevent chattering.

13. A simple and comparatively accurate rule to determine the required number of square feet of direct radiation is as follows: multiply the sum of glass surface and equivalent glass surface in square feet by the difference between the desired temperature of the room and that of the external air; divide this product by the difference between the temperature of the heating surface and the desired temperature of the room.

The equivalent glass surface referred to is obtained by dividing the exposed wall surface by 10.

When the building under consideration is of fair construction, add 25 per cent to the above, and if of poor construction, an additional 50 per cent of radiating surface is to be recommended. O. H. H.

Taking Up Wear on Engine Bearings

AT WHAT PART of the stroke should an engine be placed when taking up for the wear of wrist or crankpin boxes?

2. How would you take up on the quarter boxes of the main bearings of an engine in operation?

3. Why are the tubes of Stirling water-tube boilers curved? W. H. P.

ANSWERS

IT MAKES comparatively little difference where the engine is placed when taking up wear on the crankpin, since the wear is reasonably uniform; but for taking up on the wristpin it is best to have the engine set with the crank at the 90-deg. point, since there is a tendency for the wristpin to wear oval, and if made with the crank horizontal, adjustment is likely to take up too much wear, so that the box may bind on the wristpin when the crank comes to the 90-deg. point. The same thing applies in regard to the crankpin, but to a much less degree.

2. Main shaft bearings with quarter boxes have the adjustment in one of 2 ways; either a wedge adjustment, in which the wedge forcing the quarter boxes against the journal, is controlled by a nut and lock nut on top of the box, or by adjusting screws passing through the sides of the main bearing. In either case, the adjustment is made by turning up on the adjusting nut or screw a very little at a time until the play is eliminated. Great care should be taken in doing this, since there is always danger of getting the quarter boxes too tight, or if the adjustment is of any great amount, of throwing the shaft out of square with the cylinder.

3. The tubes in the Stirling boiler are curved at the ends so that they may enter the drums at right angles. With the tubes set as they are on an inclination, if the ends were straight, they would come into the drum on an angle to the shell, and it would be impossible to make a tight joint. A. L. R.

Determining Strength of Rope

WHAT IS the most practical method of testing a rope for strength? SUBSCRIBER.

A. The practical method of testing a rope is to put a weight on it and see how it stands up to the strain. The surface of a rope may seem all right, but if it has been dried out and used for a considerable time over small pulleys, the chances are that the inner fibers, or strands, have been considerably broken.

The preferable method is to put the rope under strain and run it over a pulley. It can be used in this way for raising a weight considerably in excess of that which is to be handled in actual use, and thus every point of the rope can be tested out. Putting on a breaking strain at one end of the rope will not serve, since the ends are the least likely to be worn, and a weak spot in the middle of the rope may cause disaster.

Manufacture of Steel

WHAT IS the difference between the "basic" and "acid" methods of manufacturing steel? C. E.

A. IN THE "basic" or Thomas and Gilchrist process, the lining of the converter is of magnesian limestone, and limestone additions are made to the bath so as to keep the slag basic, and the phosphorus of the pig iron enters the slag. By this process, ores formerly unsuited to the manufacture of steel have been made available.

In the "acid" process, the lining of the converter is a silicious material which has no effect on the phosphorus, with the result that the phosphorus in the pig iron remains in the steel.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Construction of Polarity Indicator

I WOULD like to know how to make a home-made polarity indicator. I have occasion to use this instrument quite often and would appreciate any information upon the subject which the readers may have to offer.

J. W.

Cleaning Gage Glasses

RELATIVE TO the discussions which have of late appeared on these pages as to the proper method of cleaning gage glasses, I wish to state that I obtain satisfactory results by removing the glass and placing it in a bottle of hydrochloric acid for about 20 sec. It will then be as clean and clear as a new glass.

Should it, however, be coated with oil, which the hydrochloric acid may not readily remove, I take a short length of sash cord, unravel the end, dip it into kerosene and work it back and forth through the glass. E. M. W.

Proper Boiler Operation; Setting Engine Valves

IN ANSWER to the questions relative to starting fires under Stirling boilers asked by A. V. W. on page 191 of the Feb. 1 issue of Practical Engineer, I would state that it is always desirable to start fires some time before a boiler is wanted, so that the intensity of the fire can be gradually increased and the evil effects of unequal expansion reduced to a minimum.

When the boiler must be placed on the line at short notice, it is better to go slowly until a pressure of about 30 lb. is reached, because by then the several boiler parts are under an equal expansion strain and the result of forcing the fires will not be so detrimental.

With superheaters it is best to start the fires slowly, and when a pressure of about 30 or 40 lb. is reached, gradually increase the rate of firing.

For the information of J. E. N. relative to the adjustments of the valve gear of his 14 by 36-in. Lane and Bodley Corliss engine, I submit the following.

By removing the rear valve bonnets, lines representing the port opening, lap and lead will be found on the ends of the valves and on the cylinder. On the end of crank-end steam bell crank lever under the cap and on the hub of the exhaust valve at the crank end of the cylinder a center line is made. A line will also be found on the bonnet. By causing these 2 lines to come together, the bell cranks will be in the center of their travel. If the head-end valves do not come to their center lines when the crank-end ones do, adjust the reach rod connecting the head and crank-end bell cranks.

Have the 2 eccentrics turned loose on the shaft and adjust the eccentric rods to make the bell cranks move to the end of their travel in each direction, as shown by the marks on the bell crank hubs and those on the bonnets. Put governor on safety pin.

Place the bell cranks for the steam valves in the center position as shown by the lines referred to, and adjust the valve rods until the steam valves show negative lap; that is, are open when in the center of their travel, and see that the marks on the ends of the 2 valves correspond. Turn the steam eccentric until the steam valve lever on the head end has moved to its limit of travel to pick up the steam valve and adjust the dashpot rod so that the closing shoulder on the hook will clear the lifting block by about 1/16 in. Repeat this on the other end. Place the crank on the head-end dead center and turn the steam eccentric until it is nearly ¼ revolution behind the crank so that the lines on the steam valve nearest the piston are in line with the line showing the edge of the steam port.

Turn the exhaust eccentric ¼ of a revolution behind the crank until the lines on the exhaust valve away from the piston register with the line showing the edge of the exhaust port in the cylinder. Now secure the eccentrics and turn engine over in direction of rotation to the other dead center, seeing if the marks on valves and ports coincide. If not, adjust the rods connecting the bell cranks until they do.

To set the governor, raise the balls to the center of their travel and block them. Turn the engine over slowly in the direction of rotation until the crank-end steam valve is released. Measure the distance the crosshead has traveled. Continue to turn the engine over until the head-end steam valve is tripped. Measure the travel of the crosshead, adjusting the reach rod connecting the 2 steam valves until the head-end cutoff agrees with the crank end.

Raise the governor to its highest plane and see that the safety cams release the steam valves before the ports are opened. Drop the governor to its lowest position and see that the cams do not let the hooks pick up the steam valves.

Variations in speed of not over 2 per cent can be made by changing the tension on the governor spring and the location of the balls can be changed on their arms to alter the speed; but for a decided change in speed a different size of governor pulley should be employed.

When the governor hunts, screw the balls down on their arms a little, which will increase the speed. To restore the proper speed, slightly reduce the tension on the spring. If the governor is slow in responding to changes in load, move the balls in on the arms and release spring tension. If the tension on the spring is too little or the balls are down too much on the arms, the governor will not be sensitive.

All changes in governor adjustment must be carefully made and little at a time; then observe the result before making any other changes. RECEIVER.

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Development and Control of Water Powers

In response to a call from Congress for information as to development, ownership and control of water powers and sites, the Department of Agriculture by O. C. Merrill, Chief Engineer of the Forest Service, gives a mass of information in the form of a Water-power Report, from which the following is abstracted.

Growth of the industry from 1902 to 1912 was taken from census reports and data as to public service development and larger industrial water powers from a special census of 1915. Control and inter-relation of companies was studied from data for 1914. Minimum power is taken to mean the power that could be developed by the use of an average flow for the year equal to the minimum for the lowest consecutive 7-day periods in each year. Maximum power is taken as that which could be developed from use of average stream flow continuously available for 6 months during the year. Efficiency is figured as 75 per cent, and this basis gives the minimum resources as 27,943,000 hp. and maximum as 53,905,000 hp., of which the National Forests contained 30.4 per cent of the total minimum and 31.3 per cent of the total maximum for the United States.

Concentration of these powers is remarkable and significant. Of the total for the country, 72 per cent is found in the Mountain and Pacific States, and 42 per cent in Washington, Oregon and California. Also 99.75 per cent of the power found in the National Forests are in the western states.

In 1912, the total horsepower of prime movers in the U. S. was reported as 30,448,246, of which 22.9 was in commercial central stations operated by public utility companies, 1.8 per cent in municipal stations, 12 per cent in electric railways, and 63.2 per cent in manufacturing plants. Of this total primary power, 4,870,320 hp., or 16 per cent was water-power, about half of it in central stations, 3 per cent in municipal stations, 10 per cent in railways and 40 per cent in manufactures.

Steam power, of which there was 24,339,820 hp., or 80 per cent of the total power of the country in 1912, was divided 20 per cent in central stations, 2 per cent in municipal plants, 12 per cent in street railways, and 66 per cent in manufactures. Pennsylvania, New York and Ohio had over 34 per cent of the total steam horsepower.

In the electrical industry, including commercial and municipal stations for power, light and railways, the rate of increase in water-power development from 1912 to 1915 was 3 times as great as the rate of increase for steam power.

As to relation of developed water-power to total estimated as possible, in all the geographic groups except the Mountain and Pacific states, the total primary power installed was in excess of the estimated minimum potential water-power resources, and in 5 groups the installed power was in excess of the estimated maximum resources without storage. Hence, in New England, Middle Atlantic, North Central and West South Central sections, the power now installed is 70 per cent in excess of what the water-power alone could supply, if all power sites were developed. These groups include 70 per cent of the total population of the country, and for these,

water-power can never supersede steam power, as not sufficient is available to meet demands.

Development of primary powers in the west has been tremendous, an increase of 240 per cent from 1902 to 1912, and in water-powers the increase was 450 per cent. Installed water-power per person was in 1912 4 times as great as in the remainder of the United States, and this high rate of increase and amount per capita has continued since 1912, so that while for all purposes except manufacturing, use of electricity is greater in the western states than elsewhere, present installation is considerably in excess of maximum demands, especially in California, Washington and Oregon.

As to use of power sites in National Forests and other public lands, 30 per cent of the developed water-power in the western states is in occupying forest lands for some part of the development; 12 per cent more depend on storage reservoirs located on forest lands, and another 14 per cent are dependent for location of plant or storage on public lands other than forests. So that 56 per cent of western states water-power development is utilizing public lands of the U. S. in one way or another, under existing law. This seems a sufficient answer to the statement that the Government is hindering water-power development, but in addition to this, there are on National Forests hydroelectric plants now under construction aggregating 123,000 hp., final permits granted for 420,000 hp. not yet started, and surveys under way for plants totaling 354,000 hp.

As to concentration of control power, in 1902 11.2 per cent was held by central stations, and in 1912 23.8 per cent. In the Mountain States in 1912 50 per cent of all primary power was owned by public service companies and in the Pacific States 54 per cent. In 1915, 90 per cent of the primary power in the 2 groups of states was owned by public service corporations. In the South Atlantic States it is estimated that the per cent has increased from 20 in 1912 to 50 in 1915.

As to ownership, 35 corporations are found to control, by ownership of properties, stock or lease, or by direct management, half the public service power in the country; 16 control ⅓, and 10 control ¼. In public service water-power developments, 18 corporations control ½, 9 control ⅓, and 6 control over ¼. Interrelations through common directors is more difficult to tabulate, and the report gives no conclusive data on this point, but charts are shown indicating as well as may be this inter-relation.

Civil Service Examinations

U. S. Civil Service Commission announces an examination for aid, qualified in engineering, on Mar. 8, 1916, to fill a vacancy in the Bureau of Standards, Pittsburgh, Pa., Department of Commerce, at $840 a yr., and vacancies as they may occur at salaries ranging from $600 to $840. Applicants must be graduates from a mechanical training, technical, or scientific high school, or have equivalent training. Applicants must have reached their eighteenth but not their twenty-eighth birthday on the date of the examination, and must submit to the examiner their photographs, taken within 2 yr. Apply for Form 1312, stating the title, Aid, Qualified in Engineering (Male), to the U. S. Civil Service Commission, Washington, D. C.

U. S. Civil Service Commission announces an examination, Mar. 7, 1916, for mechanical draftsman, Ordnance Department at Large, to fill a vacancy at $1320 a year in Frankford Arsenal (War Department), Philadelphia, Pa. Applicants will not be assembled for examination, but will be required to submit with their applications one specimen of pencil drawing (mechanical, and if possible, a drawing of some optical instrument), and a tracing thereof. The equivalent of a high school education, and at least 3 yr. experience as draftsman, of which not less than 1½ yr. have been on the drafting and design of telescopic instruments or optical instruments of similar character, are prerequisites for consideration. Age, 18 yr. or over. Apply for Form 1312, stating the title, Mechanical Draftsman, Ordnance Department at Large, to U. S. Civil Service Commission, Washington, D. C.

U. S. Civil Service Commission invites attention to the examination for marine engine and boiler draftsman, on Mar. 15 and 16, 1916, to fill a vacancy in the Machinery Division of the U. S. Navy Yard, New York, N. Y., at $5.04 a day, and vacancies as they may occur in any U. S. navy yard or naval establishment or in the Department at Washington, D. C., at entrance salaries ranging from $3.52 to $5.52 a day. For the lower-salaried positions the applicant must have had a 2-yr. engineering course in a recognized technical school and at least 2 yr. experience, of which at least 1 must have been in marine engine and boiler drafting; or have had the equivalent of a high-school education and 4 yr. experience in marine engine and boiler work, of which not less than 1 yr. was practical experience in drafting. Applicants must submit to the examiner on the day of the examination their photographs, taken within 2 yr. Apply for Form 1312, stating the title, Marine Engine and Boiler Draftsman (Male), to the U. S. Civil Service Commission, Washington, D. C.

U. S. Civil Service Commission invites attention to the examination for ship draftsman, scheduled to be held on Mar. 15 and 16, to fill vacancies as they may occur in this position, grades 1 and 2, in the Bureau of Construction and Repair, Navy Department, Washington, D. C., and at any U. S. navy yard or naval establishment. The entrance salary for grade 1 ranges from over $4 to $5.04; for grade 2, from $3.28 to $4 a day. Persons appointed are eligible to promotion in the service of the Navy Department to salaries of $7.52, $8, and, in a few cases, as high as $10 and $12 a day. The applicant for grade 1 must show that he has graduated from a technical school or college of recognized standing, and that he has had at least 2 yr. experience in shop work or drafting; or, lacking a degree, that he has had at least 5 yr. experience in shop work, of which 3 yr. were in the drafting room. The applicant for grade 2 must show that he has graduated from a technical school or college of recognized standing; or that he is a senior student and expects to graduate within 6 mo. from the date of the examination; or that he has had at least 3 yr. experience in shop work, of which at least 1 yr. was in the drafting room. Age, 18 yr. or over on the day of the examination. Applicants must present to the examiner their photographs, taken within 2 yr. Apply for Form 1312, stating the title, Ship Draftsman (Male), to the U. S. Civil Service Commission, Washington, D. C.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Insuluminum

SOMETIME ago an extremely important announcement came from the General Electric Co. laboratory, one of the largest and finest equipped research laboratories in the world, to the effect that a successful process for the protection of metal subjected to high temperatures had been discovered. This process, which was originally called "calorizing," has the effect of producing a rich aluminum alloy upon the surface of the metal to be protected. In a word, the metal is insulated with aluminum, and it is from this that the trade name, adopted by the Diamond Power Specialty Co., Insuluminum, originated.

The process by which Insuluminum is produced consists briefly in packing the parts in a mixture, consisting

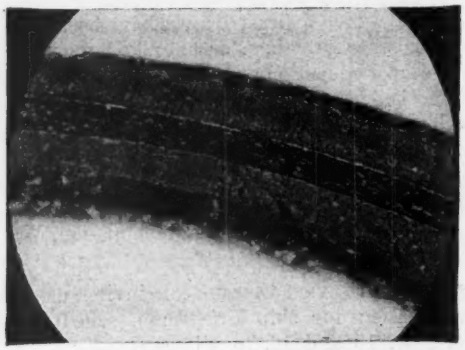

FIG. 1. PHOTO-MICROGRAPH OF INSULUMINUM UNIT, SHOWING 5 LAYERS. IN THE OUTER ONES ALUMINUM PREDOMINATES; THE MIDDLE LAYER IS THE ORIGINAL METAL

of alumina, powdered aluminum and ammonium chloride, which is contained in a gas-tight crucible. The crucible is filled with a reducing or inert gas to prevent the burning of the aluminum, and temperature is slowly increased until it reaches 1742 deg. F. The pieces are subjected to this treatment for approximately 3 hr., resulting in an absorption of aluminum by the metal to form an alloy. A microscopic examination of the piece of metal that has been treated in this manner shows clearly that the aluminum is actually absorbed by the metal and does not simply attach itself to the metal, as seen in Fig. 1.

Insuluminum was not adopted for use in the Diamond Soot Blower System until after the experimental stage had been passed. Simple but effective tests proved that this metal was all that was claimed for it.

Numerous tests that have been made by chemists and engineers connected with the research laboratory in which Insuluminum originated, and the tests conducted by other engineers have clearly proven the ability of this metal to withstand successfully exposure to combustion gases without deterioration, at a temperature from 800 to 1700 deg. greater than the uncalorized metal can withstand.

An interesting experiment was made with the 2 caps illustrated in Fig. 2; A is an Insuluminum cap, B is extra heavy steel. These 2 caps were placed directly over the fire through the furnace door of a Stirling boiler, where the temperature was about 2500 deg. F. When B began to melt both were withdrawn and plunged

FIG. 2. EFFECT OF EXPOSURE TO COMBUSTION GASES IN FURNACE OF A STIRLING BOILER AT 2500 DEG. F. ON INSULUMINUM CAP, A, AND EXTRA HEAVY STEEL CAP, B

into cold water, and shortly afterwards this photograph was taken. An exposure of a few moments longer and B would not have been recognizable. A is in apparently as good condition as before it was exposed to the flames.

Of course, soot blower units are not exposed directly to the fire, neither does the temperature of the gases of combustion ever reach 2500 deg., or near this mark in the passes of the boiler where they are used, but this test clearly showed to what a marked degree the melting point of a metal is increased by the calorizing process.

Somewhat similar to the previous test was one made, using 2 pieces of pipe. It was originally planned to

expose these to combustion gases for a long period of time, but at the end of 8 hr. the test was concluded because the uncalorized pipe was so badly deteriorated.

In connection with the piece of insuluminum pipe used in this experiment, it is interesting to know that it had previously been used in other experiments, during which it had been alternately heated to 1832 deg. F., and cooled in an electric resistance furnace open to the air. The total time during which the maximum temperature was maintained was about 50 hr.

Another rather extreme test applied to this same pipe was heating it to 1652 deg. F., and plunging it into cold water after it had cooled to a dull red. This was repeated 3 times and the surface showed no signs of cracks or any tendency to scale.

In another test, 2 pieces of pipe, one Insuluminum, the other extra heavy wrought iron, were run side by side in a furnace at 1500 deg. F., in an atmosphere of sulphur dioxide for 4 hr. At the end of this time, the ordinary pipe was so badly affected by this deleterious atmosphere that the experiment had to be discontinued. The Insuluminum pipe was in as good condition as before the experiment.

FIG. 3. INSULUMINUM PIPE, A, AND PLAIN PIPE, B, AFTER SULPHUR DIOXIDE TEST

About a year ago trial installations of Insuluminum units were made in all the different types of water-tube boilers, these units being placed at locations in the passes where the temperature reached 1800 deg. F., and meeting conditions without showing any sign of disintegration from long exposure to combustion gases at the high temperature mentioned. Over 200 installations of this unit have already been made and the results have come fully up to the expectations.

One instance proves the ability of these units to withstand the continuous exposure to combustion gases at high temperatures. A boiler was being pushed hard and developing 700 hp., which was 300 hp. over its rated capacity. The temperatures developed were so high that a large ragged hole was burned in the water-back of the stoker in spite of the water it contained. Only 3 ft. away, in the lower part of the first pass of this boiler, was an Insuluminum unit, which showed no effects from its exposure to this intense heat, and recently was found to be in perfect condition.

This demonstrates that these units can be placed at the locations in any of the passes where they are most needed to clean the boiler efficiently without being impaired by exposure to the hot gases of combustion.

Curve Recording and Analyzing Devices

AMONG the recent developments of instruments for the solution of engineering problems are a curve recording device and a curve analyzing device known as a "Polar Oscillograph Attachment" and a "Harmonic Analyzer" respectively. These devices are extremely useful to obtain a quick and accurate analysis of any periodic wave, such as the current or voltage wave of a motor, generator or power system.

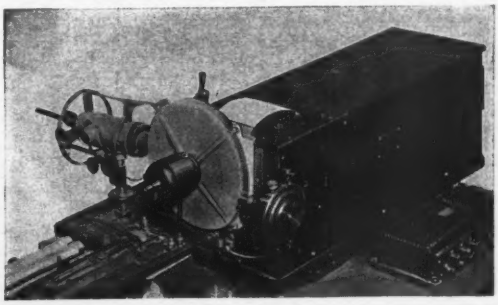

FIG. 1. POLAR OSCILLOGRAPH ATTACHMENT

FIG. 2. HARMONIC ANALYZER

Figure 1 shows the polar oscillograph attachment used to obtain a polar oscillogram of the wave which is to be analyzed. This attachment can be used interchangeably with the regular rectangular film holder on the standard oscillograph. The oscillogram is made on a photographic film about 10 in. in diameter, and is then printed on a sensitized piece of bristol board, from which a template is cut for use on the analyzer.

Figure 2 shows the analyzer, which has been designed to give any one harmonic at a time, odd or even, as high as the fiftieth. The procedure for analyzing is extremely simple and entirely mechanical. Although the operation of the machine is based on the Fourier theorem, the actual procedure for analyzing can be performed by a person without any knowledge of the mathematics involved.

This device can be applied to electrical problems of wave shapes of generators, and problems arising from the paralleling of generators, or cross currents in machines or transformer connections.

The use of the analyzer, however, is not limited to electrical problems. Any periodic wave, such as sound waves, waves of magnetic flux, torque curves of gas engines, can be analyzed and the related waves derived by simple mathematical transformation.

These new devices are manufactured by the Westinghouse Electric and Manufacturing Co., and received a bronze medal at the Panama-Pacific Exposition.

REPORT OF the work of the United States Coast and Geodetic Survey, as shown in the Annual Report of the Superintendent, gives a graphic description of the work done on the 4 maps already completed for hydrographic work, and emphasizes the lack of suitable vessels for this work, as 3 of the older vessels have been condemned as no longer safe, 2 others are fit only for work in sheltered waters, and only one vessel is now altogether fit for offshore work.

The wire-drag system of charting the bottom of the ocean is now used, which is found much more accurate than the leadline soundings, as it discovers submerged rocks and ledges which are liable to be missed by the older method.

Work in the interior of the continent on triangulation and the establishing of precise level bases has been carried forward, the ultimate goal being the establishment of sufficient of these bases so that no place in the country shall be more than 100 miles distant from a primary triangulation station, or a precise level bench mark. Further work is needed in Alaska, both for interior triangulation work and hydrographic survey.

The under-water work is of the greatest importance to navigators in making sailing on coast waters safe, and the interior triangulation work is essential in establishing boundaries and levels for the records of titles and undertaking of improvements.

Various recommendations in regard to appropriations, detail changes in methods of handling the work, and for improved equipment are given in the report, also appropriations are asked for further parties for field work and clerical labor for offices and sub-offices at the main points, where the data collected is reduced to usable form; also a system is recommended for the retirement of officers of the Coast and Geodetic Survey, on a basis similar to that given to the Coast Guard Service.

The work of the Survey during past years is of a value hardly to be estimated, and the fact that in the last 5 yr. of work on the Under-Water Surveys, an area of over 1300 sq. mi. has been examined, and over 3400 shoals, ledges, and rocks located, indicates something of the advantage that comes from such work.

News Notes

THE NEW YORK STATE CONVENTION OF STATIONARY ENGINEERS next summer, will be held in Yonkers, N. Y., instead of Niagara Falls, as accommodations could not be secured at the Falls for exhibitors.

SUBSTITUTION of nitrogen filled lamps for arc lamps now in use in Fredericton, New Brunswick, is being considered, the change involving the purchase of a new dynamo, 2 transformers, 2 rectifiers and other supplies.

FRANK MORRISON, sales manager for Mason Regulator Co., Boston, Mass., is making a trip through the southeastern portion of the country and to important points in Cuba.

OPPORTUNITIES listed by the Bureau of Foreign and Domestic Commerce include a motor of 125 hp., 550 v., d.c., for Canada, and supplies for electric light installations for Italy. Details may be had from the Bureau, Washington, D. C.

OWING TO the enormous increase in transportation rates from Canada to European ports, the Canadian mill of the Keasbey & Matison Co., asbestos manufacturers, at LaChine, Canada, will be removed to the Ambler plant, which will make this industry the largest in the world.

THE COPPUS ENGINEERING & EQUIPMENT CO., of Worcester, Mass., reports the recent sale of 9 Coppus turbo blowers to the Haverhill Boxboard Co., of Haverhill, Mass., the result of a comparative test with another blower, the blowers being installed under boilers standing side by side.

THE NEW YORK OFFICE of the Ohio Brass Co. was moved, on Feb. 12, to new quarters, 8 floors above its former location, the new office being in the same relative location as the old—merely 8 stories higher.

The address is 1822 Cortlandt Bldg., Hudson Terminal, 30 Church St.

DIRECTORS OF the Society for Electrical Development held a meeting on Jan. 24, in New York City, and decided that another great Electrical Week will be held during the year 1916, the date and name to be decided later.

A large representative gathering of men prominent in the electrical field was present, the entire day being given up to the consideration of the Society's problem. An appropriation was made for furthering a spring house wiring campaign to coordinate the activities of various manufacturers and electrical companies in this line, and increase this activity by making the campaign nation-wide. Details are to be announced later.

AN IMPORTANT CONFERENCE on drainage and related subjects will be held at the University of Illinois under the auspices of the Department of Civil Engineering, Mar. 8-11, 1916. Land reclamation, flood protection, levee construction, and the importance of such work to the agricultural interests of the State are subjects which will be discussed by engineers and contractors who have specialized in such work.

The program includes the names of such men of prominence as: George Parsons, president of the National Drainage Congress; Edmund T. Perkins, and Isham Randolph, consulting engineers; S. H. McCrory,

Chief of Drainage Investigations, U. S. Department of Agriculture; and W. L. Park, Illinois Central Railroad. The practicability will be considered of having an annual short course in drainage engineering under the direction of Professor F. H. Newell, head of the Department of Civil Engineering and formerly director of the United States Reclamation Service. All who are interested in the subjects mentioned are cordially invited to attend. The Department of Civil Engineering, Urbana, will send full information on request.

APPRECIATING the great importance to be attached to work along educational lines in connection with its numerous activities, the Westinghouse Electric & Mfg. Co., has announced the formation of an Educational Department with Channing R. Dooley as manager. For some years past, Mr. Dooley has been in charge of the company's educational activities and this appointment is simply an enlargement of the scope of this work and a recognition of its importance.

He has been closely identified with the welfare work of the Westinghouse Electric Co., particularly the Westinghouse Club, Savings Fund, and Apprenticeship courses, and has been secretary of the Educational Committee, as such having direct charge of the employment and location of all apprentices employed by the company.

ON ACCOUNT OF the requests for additional time, the Diamond Power Specialty Co., of Detroit, announces that the closing date of its prize article contest has been extended to Apr. 1. All articles should reach the company at its Detroit, Mich., office by that date.

Cash prices totalling $100 have been offered for the 5 best articles on Mechanical Soot Blowers, those eligible to compete being consulting engineers, chief engineers, engineers in charge of plants, and engineers operating power plant machinery. Full information in regard to subjects and conditions may be had by addressing the company at Detroit.

THE INTERNATIONAL ACHESON GRAPHITE CO., of Niagara Falls, N. Y., has changed its name and hereafter will be known as Acheson Graphite Co. It will be noted that the word "International" has been dropped and that the company name now begins with the name of the noted inventor of the process for making graphite artificially in the electric furnace. The change was brought about through the conception that the word International had no significance in the company's business and only served to conceal identity when indexes and other references were examined for the name and address.

R. L. WILSON, manager of the Railway Division of the Westinghouse Electric & Mfg. Co., East Pittsburgh works, has been appointed assistant general superintendent, looking directly after trades apprentices, employment, working conditions and other matters of a similar nature.

Mr. Wilson was born in Shelbyville, Ind., and is a graduate of Rose Pyrotechnic Institute of that state. He entered the employ of the Westinghouse Electric & Mfg. Co. in 1893 as a student draftsman, and subsequently became inspector, engineer of construction, and later superintendent of construction, at one time being in charge of erection work in the New York District. Later, Mr. Wilson was made superintendent of the Railway Division, which position he continues to hold.

He is chairman of the joint committee appointed by the company and the employes for the settlement of differences in opinion arising between the employes and the company, and is also trustee of the Veteran Employes Association of the Westinghouse Electric Co.

THOMAS F. WILLIAMS, formerly chief mechanical engineer of the Aeromarine Plane and Motor Co., of Avondale, N. J., and a specialist in carburization of fuels, has accepted the position of chief consultant of the Board of Engineering Research, Mechanical Applications, of the Powdered Coal Engineering & Equipment Co., of Chicago, and will direct the research work of that company in the carburization of comminuted fuel and the application of automatic mechanical regulation and controls thereof.

THE SOCIETY FOR ELECTRICAL DEVELOPMENT, at 29 W. 39th St., New York City, is starting its campaign for a "Wiring of Homes" month, Mar. 15 to Apr. 15, and folders have been sent out showing how the campaign for such wiring may be started by any public utility organization or any concern interested in the increasing of the wiring of homes.

Income of $12 a year from each smaller residence customer is estimated, and attention is called to a 28-page booklet which the Society is distributing free, giving information in regard to successful house-wiring campaigns which have been conducted; also to the books "Standard Wiring for Electric Light and Power," by H. C. Cushing, Jr., which may be obtained of Practical Engineer in connection with a subscription; also to "Wiring of Finished Buildings," by Terrell Croft.

PRIZES AGGREGATING $2100 are offered for plans, sketches, grouping and arrangement, for the housing of immigrants in industrial towns. The competition is conducted under the auspices of the National Americanization Committee, with the cooperation of the various societies and institutes of architects and engineers. The contest closes May 1.

The prizes are divided into 2 groups. The first covers plans for the housing of workmen in industrial communities not exceeding a population of 35,000. Entries in this class include plans for (1) single family houses; (2) combined family and lodging houses, which will permit separation of the family from lodgers; and (3) boarding houses or community dwellings for numbers of single men or of single women. The first prize for this class is $1000, the second $500, the third, fourth and fifth, $100 each. In the first group, the Committee has in mind a new community produced by a new industry, with the consequent need of supplying dwelling for a large numbers of employes. A considerable proportion of these employes will be needed permanently; the rest, as the construction gangs, from 2 to 5 yr. only. In the statement of the conditions of the contest which is being issued to competitors, it is pointed out that these 2 important considerations are the welfare of the tenant and the cost. The wages of the employes for whom the houses are designed are to be from $2 a day to $20 a week. In the second group, a first prize of $200 and a second of $100 is offered for a satisfactory substitute for the derailed freight and cattle cars now used to house construction gangs on railways.

The Committee calls attention to the fact that new communities clustered around new industries are being produced in this country with phenomenal rapidity. It is the small industrial town at present, not the large city in which the "congestion" problem of the country is centered. Men flock by thousands to places where there are plenty of jobs—but no dwellings. In one New England town, families are being "evicted," not because they cannot pay rent, but because they cannot get houses for the rent they can pay. A large percentage of these workmen are immigrants who have no way of creating American standards of living for themselves. If such standards are not provided for them, and insisted upon, groups of immigrant workmen are bound to follow various Southern European standards of living and customs, vitally affecting social health and prosperity. The community that results from these conditions cannot be an American community. The aim of the contest is therefore to arouse interest in the subject, and to produce carefully worked out and entirely practicable housing plans and standards which it will be possible for employers and workmen and communities alike to demand and insist upon. In order that the result of the contest may be made immediately available, it will be followed by public exhibits not only of the results of the competition but also of any plans now in existence, or in process of execution, which architects, engineers, employers or corporations may care to submit. Inquiries may be addressed to the National Americanization Committee, 20 W. 34th St., New York City.

TRYGVE D. YENSEN, First Assistant in the Engineering Experiment Station in the Department of Electrical Engineering of the University of Illinois, has recently been made the recipient of an unusual expression of appreciation from the officers of that institution.

In response to the recommendation of the Dean of the College of Engineering, seconded by all of the heads of departments of the College, and with the approval of the President, the Trustees, in recognition of Mr. Yensen's significant service in the development of engineering research, voted that he be promoted, which took effect Jan. 1, 1916, to Research Assistant Professor of Electrical Engineering.

It is unusual for the Trustees to make promotions in the middle of the college year, and they were constrained to such action in the case of Mr. Yensen because of his success in the development of alloys of iron possessing remarkable electrical properties. He has not only duplicated what other investigators have done, but he has produced metal, the magnetic permeability of which is many times greater than any that has before been produced. It is understood also that he has not only done this once, but his procedures have been so systematic that he can duplicate with certainty any result which has thus far been obtained. His work has attracted wide attention and visitors to his laboratory have come from every part of this and other countries. Mr. Yensen's results have been obtained through the melting of metals in vacuo by the use of an electric furnace.

Mr. Yensen was born in Christiania, Norway, in 1884. He graduated from the University of Illinois in 1907 with the degree of Bachelor of Science in Electrical Engineering, and he received the degree of Master of Science in 1912 and of Electrical Engineer in 1913. The thesis which he submitted in partial fulfillment of the requirements for the Bachelor's degree won for him in 1907 the Edison Medal conferred by the American Institute of Electrical Engineers. After graduating, he served for a time in the Testing Department of the General Electric Co. of Schenectady, New York, and later as Assistant Engineer of the Shawinigen Water and Power Co. of Montreal, Canada. In 1910, he became Assistant in the Engineering Experiment Station in the Department of Electrical Engineering of the University of Illinois.

He is the author of a considerable number of scientific papers and of the following bulletins of the Illinois Engineering Experiment Station:

No. 55, Starting Currents of Transformers, with Special Reference to Transformers with Silicon Steel Cores; No. 72, Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo; No. 77, The Effect of Poron upon the Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo; No. 83, The Magnetic and Other Properties of Iron-Silicon Alloys Melted in Vacuo.

U. S. CIVIL SERVICE COMMISSION announces an examination, Mar. 7, for Chief of Editorial Division, to fill a vacancy in the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., at a salary of $2500 a yr., the appointee to have charge of the Editorial Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce. Experience in responsible editorial work having to do with foreign trade; or graduation with a bachelor's degree from a college or university of recognized standing, and at least 2 yr. actual experience in any responsible editorial work; or 2 yr. college training and 4 yr. of such experience; or, for persons lacking collegiate training, 6 yr. of such experience are prerequisites for consideration. Applicants must not have reached their fiftieth birthday on the date of examination. Apply for Form 1312, stating the title, Chief of Editorial Division (Male), $2500, to the U. S. Civil Service Commission, Washington, D. C.

Books and Catalogs

EXAMPLES IN MAGNETISM, by F. E. Austin; Hanover, N. H., 1916; 90 pages, 27 illustration; price, in flexible leather, $1.10.

The general layout of this book consists of 12 lessons containing numerous examples and problems which are simple applications of the laws or principles of physics and mechanics, in both their quantitative and qualitative aspects. The scheme employed as far as the quantitative is concerned, is to furnish a guide for beginners in the study of electrical engineering arranged in a manner which enables them to develop the process of correct and logical thought.

Carefully stated examples with the algebraic or symbolical expression denoting the physical law applying and the required data, systematically arranged, are first given; these are then followed by their respective solution, the process of which is explained step by step. Following the examples are problems dealing with some phase of the same subject, the solution of which is left to the student.

Derivation and discussions of the various equations employed are not taken up, being in general taken for granted as a matter of fact, the main object of the author being to outline the mathematical processes involved in the transposition of the members of equations, and in the solution of the equations expressing physical laws to obtain useful numerical results.

While not essential, it may be preferable for those desiring to peruse the contents of this little volume, to possess a working knowledge of the subjects of algebra, trigonometry and physics. The numerous illustrations and diagrams employed, aid the student in a ready comprehension of the subject.

MARINE AND STATIONARY DIESEL ENGINES, by A. H. Goldingham; 206 pages, 135 illustrations; New York, 1915; price, $3.

The first chapter of this book is devoted to a more or less theoretical discussion of the Diesel engine, and includes such subjects as the characteristics of the Diesel cycle, comparisons of cycles, diagrams, valve motions, efficiencies and heat balance. The other 8 chapters are more of a practical nature, including details of construction, indicator cards, marine. Diesel engines, operation and correction and types of engines.

The discussion on marine engines, and the technical descriptions of the many different types of horizontal vertical, slow-speed and high-speed marine and stationary engines, drawing attention to special features of construction of these types, should be of value both to the technical and the non-technical reader. The chapter on "Operation and Correction" will be found of great value to those wishing to study its operation or who are operating Diesel engines, while the formulas for design and construction, many of which are stated to be original with the author, will prove of value to designers and draftsmen.

Ship drawings and photographs of various types of engines on the market at the present time are used as illustrations.

HANDBOOK OF CARBURETION, by A. B. Browne; 137 pages, 47 illustrations, cloth; New York, 1916. Price $2.00.

Even though known to be indispensable, the carburetor used in connection with internal combustion engines has been considered more as a necessary evil than otherwise. Excepting for instances of faulty design and construction, much of this prejudice may be traced to lack of knowledge of this piece of apparatus on the part of the operator. From the information to be gained from this book, many of the carburetor troubles heretofore considered unavoidable may be eliminated, and as a result this volume ought to prove of great value to the designer, builder, owner or operator of internal-combustion engines.

The opening chapter is devoted to the Theory of Carburetion; Chapter II, to The Intake Manifold; Chapter III, to Carburetor Testing; Chapter IV, to the subject of The Practical Testing of Motor Vehicles; while the following chapters take up Direct Determination of Carburetor Action, The Chemistry of Carburetion, The Physical Conditions of Carburetion and The Carburetor of The Future, respectively.

Prevailing methods of carburetor testing are discussed in detail and methods outlined. Detailed directions are given for the use of the Accelerometer in road testing and in the chapter devoted to motor-vehicle testing on traction drums, comparative results of such tests are found.

The chapter on The Chemistry of Carburetion treats of the physical effects of different mixture proportions and outlines a method of exhaust gas analysis and the interpretation of results obtained therefrom.

An appendix of many useful tables and convenient formulas is inserted.

THE COMMITTEE OF MANAGEMENT, International Engineering Congress, 1915, announces that the volume on Mechanical Engineering is ready for distribution and the members who have subscribed to this volume will soon receive it. The other volumes will be issued as rapidly as possible. Owing to the large amount of material to be reprinted, and the thousands of copies to be bound, the work cannot be carried on with greater speed; however, it is hoped that within 2 mo. the entire set will be completed. Members who did not send in their final selections may be disappointed in not securing all the volumes they might have had in mind, and at this date the Committee has decided to close the lists for certain volumes which have been sent to the press. It may be possible to supply members who would apply at this late hour with copies of volumes which have not gone to press. Address W. A. Cattell, 426 Foxcroft Bldg., San Francisco, Calif.

MANUFACTURE AND USES of Alloy Steel, is the title of Bulletin 100, just issued by the U. S. Bureau of Mines, Department of the Interior.

Henry D. Hibbard, the author, in the introduction to the bulletin, says: "The object of this report is to give briefly information of present value relating to the manufacture and uses of the various commercial alloy steels with the hope of stimulating the demand for such steels and extending their practical use. The report is issued by the Bureau of Mines as a contribution to the increase of efficiency in the preparation and utilization of the mineral resources of the United States.

A copy of this bulletin may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

LAP WELDED steel pipe of large diameter and made from high grade open hearth steel, is the subject of Bulletin 15-9 from American Spiral Pipe Works, Chicago.

Bulletin 15-6, from the same company, describes and illustrates Taylor spiral riveted pipe for water supply and hydroelectric plants.

FROM THE A. S. DILLON Automatic Flue Blower Co., Kansas City, Mo., has been received a pamphlet describing a new type of flue blower which is placed in the setting at the rear of return tubular boilers. Catalog will be sent upon request to those interested.

A NEW BOOKLET, entitled "The Proper Care of Belts," and relating to Dixon's traction belt dressing and solid belt dressing, has been received from Joseph Dixon Crucible Co., Jersey City, N. J.

SWITCHBOARD STRUCTURAL DEVICES and accessories are illustrated and described in General Electric Co.'s new bulletin, No. 47,750, which supersedes No. 4967.

THE FOAM SYSTEM for extinguishing oil fires, is the subject of a pamphlet from National Transit Pump and Machine Co., Oil City, Pa. This pamphlet describes and illustrates several types of duplex pumps designed to meet the demands of the foam system, and explains various methods of applying foam.

CATALOG C, recently issued by The Reliance Gauge Column Co., Cleveland, O., deals with the Cleveland friction clutch, explaining its construction and advantages, and giving new price list.

HYDRAULIC MACHINERY built by Allis-Chalmers Mfg. Co., of Milwaukee, is described in Bulletin No. 1636, which illustrates several modern hydroelectric plants, showing apparatus furnished by the company.

BULLETIN NO. 25, on improved medium speed poppet valve engines for refrigerating machines and general power purposes, has just been issued by The Vilter Mfg. Co., of Milwaukee.

Trade Notes

FROM AN American consular officer in Spain comes information, details of which can be had from the Bureau of Foreign and Domestic Commerce, that in his district a representative wishes to take up American machinery. At present, urgent orders are on hand for a steam boiler, a vertical steam engine, a 3-phase alternator, an 80-hp., 3-phase motor, 2 combination grinding and pulp machines and a water feed pump.

G. W. ROOSA, for the last several years connected with the lighting department of the Westinghouse Electric & Mfg. Co., on Feb. 1, became associated with the Holiphane Glass Co., of Newark, Ohio, where he will have charge of the sales of Holiphane glassware in New York, Ohio, and Western Pennsylvania.

WESTINGHOUSE ELECTRIC & MFG. CO. has recently received a number of orders for turbines of large capacity, among which are the following:

Commonwealth Edison Co., of Chicago, has ordered for installation in its Northwest power house, Roscoe St. and California Ave., Chicago, a unit consisting of a 3-phase, 60-cycle, 12,000-v., tandem, compound, turbo generator, rated at 30,000 kw. This unit consists of a high-pressure turbine, a low-pressure turbine and one generator, all in tandem on one shaft operating at a speed of 1200 r.p.m. This is capable of carrying a momentary overload of 35,000 kw. The turbine will be served by 2 Westinghouse 28,000-sq. ft. surface condensers which are capable of maintaining, with full load on the unit, a vacuum of from 28½ to 29 in.

The Duquesne Light Co., of Pittsburgh, has purchased, for installation in its Brunots Island power house, a 3-phase, 60-cycle, 12,000-v., cross-compound turbo-generator rated at 40,000 kw. This unit consists of a high and a low-pressure turbine, driving separate generators which operate in parallel. The speed of the high-pressure element is 1800 r.p.m., and that of the low-pressure 1200 r.p.m. This unit is capable of carrying momentary overloads of 46,000 kw. It will be served by 2 Westinghouse surface condensers which will maintain, with full load on the unit, a vacuum of 28½ to 29 in.

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Position Wanted

POSITION WANTED—As Electrician and Engineer. Am experienced in installing, maintaining and repairing in steam heating, A.C. and D.C. plants. Desire to take charge where improvements will be welcomed. Address J. F. K., 877, 10th Ave., Milwaukee, Wis. 2-1-1

WANTED—Position as engineer in pumping station or in some stationary plant. I have had 4 years experience in engineering. What have you to offer? E. W. Adkins, Charleston, Ill. 3-1-1

YOUNG MAN, age 26, would like a position as helper in engine room where good advancement is assured. Am I. C. S. student. Will send information. Box 429, Practical Engineer, Chicago. 3-1-1

POSITION WANTED—As Chief Engineer or Manager of produce cold storage plant. Am familiar with gas, oil and steam engine driven plants, also with D.C. light and power of 250 volts. Erecting, repairing and operating. Employed; married, and sober. Will go anywhere. Address Box 428, Practical Engineer, Chicago, Ill. 3-1-1

POSITION WANTED—By man who has made steam engineering a life study; have had several years' experience; at present am student in Complete Steam Engineering course with I. C. S. Would like position as engineer, assistant or oiler, with reasonable salary to start, and where I can advance according to merits. Age 26. Address Practical Engineers, Box 419, Chicago, Ill. 1-15-2

POSITION WANTED—Young man wants position as helper and extra engineer in steam plant for a start. Other particulars answered by letter. Write W. D. Bellesfield, Rock Valley, Iowa. 2-1-1

POSITION WANTED—As Chief Engineer. Am qualified to take full charge of power plant, A.C. or D.C., also refrigeration. Age 30. Married. Employed. Chicago only. Address Practical Engineer, Box 421, Chicago, Ill. 2-1-1

POSITION WANTED—Sales engineer with wide experience in selling Engines, Boilers and Steam and Power Plant Specialties. Thorough mechanic, technically educated. Have developed commercial ability. Address Practical Engineer, Box 423, Chicago, Ill. 2-15-1

POSITION WANTED—Engineer wants position in light plant. Experienced with producer gas engines, A.C. and D.C. machines. Technical graduate. No habits. Prefer plant with natural gas engines. Address Practical Engineer, Box 424, Chicago, Ill. 2-15-1

POSITION WANTED—Inside of power plant by young man with a technical education, but no experience. For particulars write to K. Lufter, Kewaunee, Wis. 3-1-1

Help Wanted

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Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill.

Sparks From The Advertising Pages

Hobson's Choice

One of the little terms that has crept into the vocabulary of most business men of today is the expression "Hobson's Choice." It originated in England way back in the days when equitation was the favorite pastime of the rich. Tobias Hobson, livery man of Cambridge, England, permitted his patrons to take only the horse nearest the door. Hence, when we refer to Hobson's Choice we mean an unavoidable choice—or to put it literally—no choice at all. Just the unpleasant semi-defi, "This and no other."

We presume conditions in England have changed since the days of Tobias Hobson, that a person today has some "say-so" in the gratification of desires. This brings forth the thought that one of the best aids to a discriminative choice is the advertising section of a trade or technical publication.

When a man makes a purchase involving more than the ordinary expenditure, he invariably visits the various permanent exhibitions of the product desired with a view to making a comparison, as, for instance, when in the market for an automobile, his step is in the direction of "automobile row" or any similar exhibition section exclusively for automobiles. He inspects the machines that appeal to him and gathering the necessary literature he goes home to make a more careful comparison and selection.

Other purchases are made on the same principle. But suppose there is no section or permanent exhibition of the product desired, but that both manufacturers and agents are in remote parts of the country. True enough, with very few exceptions, there is a representative or agent in the larger cities, handling the desired product, but even these are not in one locality. In many cases the prospective buyer does not know all the legitimate manufacturers of the thing he wants.

What, then, would be his best move?

To refer to the advertising section of the trade or technical publication in the field representing the product desired. There in classification will be found the safe product to buy—**the advertised product**—and there under this classification he can make his choice or what is still better, he can get in touch with all the manufacturers who advertise the desired product therein and secure the necessary literature or trial privilege and then draw his own conclusions.

At any rate, the fact remains he must depend upon such a source for his first efforts in making a discriminative choice.

To you, engineers, let us make this admonition—use the advertising pages of Practical Engineer and use them freely when you are in the market for equipment of any kind. Whatever the price you wish to pay—whatever the nature of the purchase—whether it is the buying of a large engine or only a pound of packing, it pays well to buy the advertised product.